3.3 Riparian Vegetation

3.3.1 Affected Environment

3.3.1.1 Study Area for Mine Dewatering and Localized Water Management Activities

The study area for riparian vegetation comprises of the hydrologic study area described in Section 3.2.1, Water Resources and Geochemistry, Affected Environment. Perennial creeks within the study area typically support a riparian zone ranging in width from a few feet immediately adjacent to the creek channel to relatively wide zones on broad floodplains. Riparian areas are valuable in providing sediment retention, nutrient removal and transformation, increased production (relative to uplands) for livestock and wildlife forage, habitat diversity for aquatic and terrestrial wildlife, and streambank stability.

Two riparian habitat inventories have been conducted in the study area (Whitehorse Associates 1995a, b; JBR 1993). Riparian habitat described in JBR (1993) also was provided in the SOAP EIS (BLM 1993b). Figure 3.3-1 illustrates riparian habitat within the study area and the riparian habitat identified during these inventories. Riparian inventories have not been conducted in the northeastern portion of the study area, which includes upper Susie Creek and associated tributaries. Perennial stream reaches in the study area also are illustrated in Figure 3.2-9. Table 3.3-1 lists the types and acres of riparian/wetland vegetation located in the study area by watershed and creek within each watershed. The inventory reports completed by Whitehorse Associates (1995a, b) and JBR (1993) included other riparian vegetation types in addition to those illustrated in Figure 3.3-1. The riparian vegetation illustrated in Figure 3.3-1 and the types and dominant species provided in this discussion only include the riparian vegetation types that supported a prevalence of wetland species and were associated with perennial or ephemeral creeks or wetlands. Approximately 4,337 acres of riparian/wetland habitat occur within the study area, of which 2,025, 1,685, 228, 388, and 10 acres are associated with the Maggie Creek, Rock Creek (including Boulder Flat), Susie Creek, Humboldt River watersheds, and small tributaries to the Humboldt River, respectively.

Table 3.3-2 lists the riparian/wetland vegetation types present within the study area and the dominant species associated with each type. Eight riparian vegetation types are present including streambar, herbaceous streambar, wet meadow, Salix (willow) streambar, Salix/wet meadow, Salix/mesic meadow, Salix/mesic meadow, and ALNINC (speckled alder)/mesic meadow. These types were developed and used during the 1994 riparian habitat inventory conducted by Whitehorse Associates within the Rock and Maggie Creek basins (Whitehorse 1995a, b). Riparian vegetation types and dominant species identified by JBR in the Maggie and lower Susie Creek basins were correlated with appropriate vegetation types identified by Whitehorse Associates. Results from these inventories indicate that the streambar riparian vegetation comprises approximately 42 percent (1,812 acres) of the riparian vegetation present within the study area. Other prevalent types include wet meadow (854 acres), Salix streambar (331 acres), Salexi/wet meadow (376 acres), and ALNINC/mesic meadow (248 acres).

Approximately 621 of the 4,337 acres of riparian vegetation that occur within the study area are within or adjacent to the predicted ground water drawdown area associated with the Goldstrike Mine (Figure 3.3-1). Herbaceous streambar riparian vegetation comprises approximately 61 percent (381 acres) of the 621 acres that occur within this area. Other prevalent types include ALNINC/mesic meadow (124 acres), streambar (44 acres), wet meadow (37 acres), and Salix streambar (32 acres). An additional 3 acres of riparian vegetation is associated with Salix/mesic meadow and Salexi/wet meadow riparian habitat types. Riparian habitat types and acres present within and adjacent to the predicted drawdown area are presented in bold type in Table 3.3-1.

The condition of riparian habitats in the Rock Creek and Maggie Creek basins was evaluated by Whitehorse Associates during the 1994 field season (Whitehorse Associates 1995a, b). Five riparian condition classes were developed by Whitehorse Associates, which included very poor (<50 percent), poor (50 to 60 percent), fair (61 to

Table 3.3-1
Acres of Riparian and Wetland Vegetation in the Study Area

Watershed (*Stream*)	Area[1]	Streambar	Herbaceous Streambar	Wet Meadow	Salix Streambar	Salix/Wet Meadow	Salix/Mesic Meadow	Salexi/ Wet Meadow	ALNINC/Mesic Meadow	Total
Maggie Creek										
Beaver Creek	M1	2	1	1	0	0	0	1	47	52
Beaver Creek	M2	121	6	3	22	0	42	0	77	271
Coyote Creek	**M3**	**0**	**2**	**0**	**22**	**0**	**0**	**1**	**64**	**89**
Coyote/Spring Creeks[2]	M4	87	10	99	1	1	3	24	0	225
Little Jack Creek	**M5**	**41**	**23**	**1**	**9**	**0**	**0**	**0**	**51**	**125**
Little Jack and Jack[3] *Creeks*	M6	31	32	128	13	0	1	37	0	242
Maggie Creek	--	125	176	464	0	0	0	163	0	928
James Creek	--	1	6	0	0	0	0	2	0	9
Soap Creek	--	0	3	<1	0	0	0	0	0	3
Marys Creek	--	2	12	<1	0	0	0	3	0	17
Mack Creek	--	0	7	0	0	0	0	1	0	8
Lynn/Simon Creeks	**--**	**0**	**2**	**29**	**0**	**0**	**0**	**0**	**0**	**31**
Cottonwood Creek	**--**	**3**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**7**
E. Cottonwood Creek	--	0	<1	6	0	0	0	0	0	6
Fish Creek	--	5	3	0	0	0	0	<1	0	8
Indian Creek	--	<1	1	0	0	0	0	0	0	1
Bob's Creek	--	0	2	0	0	0	0	0	0	2
Subtotal	--	*418*	*290*	*732*	*67*	*1*	*46*	*232*	*239*	*2,025*[4]
Rock Creek										
Rock Creek[5]	R1	8	90	0	0	0	0	0	0	98
Rock Creek[5]	R2	23	78	0	0	0	0	0	0	101
Rock Creek	R3	29	171	0	0	0	0	0	0	200
Rock Creek	R4	0	74	0	0	0	0	0	0	74
Willow Creek	R5	0	107	80	12	0	0	139	0	338
Willow Creek	R6	0	102	1	2	0	0	0	0	105
Willow Creek	R7	20	69	7	1	0	0	3	0	99
Willow Creek	R8	0	4	2	0	0	0	0	0	6
Willow Creek	R9	0	70	7	0	0	2	1	0	80
Willow Creek	R10	0	4	0	0	0	0	0	0	4
Willow Creek	R11	0	0	1	0	0	1	1	<1	3
Antelope Creek	R12	0	48	0	0	0	0	0	0	48
Antelope Creek	R13	0	67	0	0	0	0	0	0	67
Antelope Creek	**R14**	**0**	**75**	**0**	**0**	**0**	**0**	**0**	**0**	**75**

Table 3.3-1 (Continued)
Acres of Riparian and Wetland Vegetation in the Study Area

Watershed (*Stream*)	Area[1]	Streambar	Herbaceous Streambar	Wet Meadow	Salix Streambar	Salix/Wet Meadow	Salix/Mesic Meadow	Salexi/ Wet Meadow	ALNINC/Mesic Meadow	Total
Antelope Creek	**R15**	**0**	**98**	**5**	**0**	**0**	**0**	**0**	**0**	**103**
Antelope Creek	R16	0	47	11	1	1	5	0	0	65
Antelope Creek	R17	0	7	0	1	0	20	0	0	28
Boulder Creek	**R18**	**0**	**118**	**1**	**0**	**0**	**0**	**0**	**0**	**119**
Boulder Creek	**R19**	**0**	**35**	**0**	**1**	**0**	**1**	**0**	**9**	**46**
Green, Knob, and Sand Dune Springs[6]	R20	0	0	0	0	0	0	0	0	0
Green, Knob, and Sand Dune Springs[6]	**R21**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Welches Creek	**R22**	**0**	**24**	**1**	**0**	**0**	**1**	**0**	**0**	**26**
Subtotal	--	*80*	*1,288*	*116*	*18*	*1*	*30*	*144*	*9*	*1,685*[4]
Susie Creek										
Cold Creek[7]	--	3	2	0	0	0	0	0	0	5
Blue Basin Creek[7]	--	2	1	0	0	0	0	0	0	3
Adobe Creek[8]	--	1	<1	0	0	0	0	0	0	1
Swales Creek[7]	--	3	2	0	0	0	0	0	0	5
Camp Creek[7]	--	2	1	0	0	0	0	0	0	3
Susie Creek[2]	--	127	77	0	0	0	0	0	0	204
Middle Susie Creek[7]	--	0	<1	1	0	0	0	0	0	1
Hot Springs Drainage	--	2	3	0	0	0	0	0	0	5
Subtotal	--	*140*	*87*	*1*	*0*	*0*	*0*	*0*	*0*	*228*[4]
Humboldt River Tributaries										
Primeaux Creek	--	<1	<1	0	0	0	0	0	0	1
Palisade Creek	--	0	<1	0	0	0	0	0	0	<1
Buck Rake Jack Creek	--	0	5	0	0	0	0	0	0	5
Dry Susie Creek	--	0	<1	0	4	0	0	0	0	4
Subtotal	--	*0*	*6*	*0*	*4*	*0*	*0*	*0*	*0*	*10*[4]
Humboldt River	--	0	141	5	242	0	<1	0	0	388
Subtotal	**--**	*0*	*141*	*5*	*242*	*0*	*0*	*0*	*0*	*388*[4]
Total	**--**	*638*	*1,812*	*854*	*331*	*2*	*76*	*376*	*248*	*4,337*[4]

Sources: Whitehorse Associates 1995a, b; BLM 1993b; JBR 1993.

Note: **BOLD** type indicates the riparian inventory areas that are within the 10-foot ground water drawdown area predicted for the Goldstrike Mine.

[1]Inventory areas used by Whitehorse Associates 1995a, b.

Table 3.3-1 (Continued)
Acres of Riparian and Wetland Vegetation in the Study Area

[2]Riparian acreage for the lower portion of Susie Creek was based on acreages reported in BLM 1993b. Riparian acreage for the upper portion of Susie Creek was based on the assumption stated in footnote 7. Riparian acreage estimates may be low since riparian habitat along upper Susie Creek has not been inventoried, and the area does support several, large wet meadow complexes.

[3]Acreage was based on Whitehorse Associates 1995b; BLM 1993b.

[4]Numbers are approximate due to rounding.

[5]Rock Creek could be affected since existing monitoring wells are exhibiting drawdown.

[6]An additional 2,819 acres of Marsh/Transition to Marsh riparian vegetation was identified in R20 and R21 that was associated with the newly formed springs in Boulder Valley. The dominant species present was *Typha latifolia* (cattail).

[7]An average width of 5 feet was assumed for riparian vegetation along these creeks since riparian inventories have not been conducted.

[8]Riparian vegetation associated with this creek has an average width of 35 feet.

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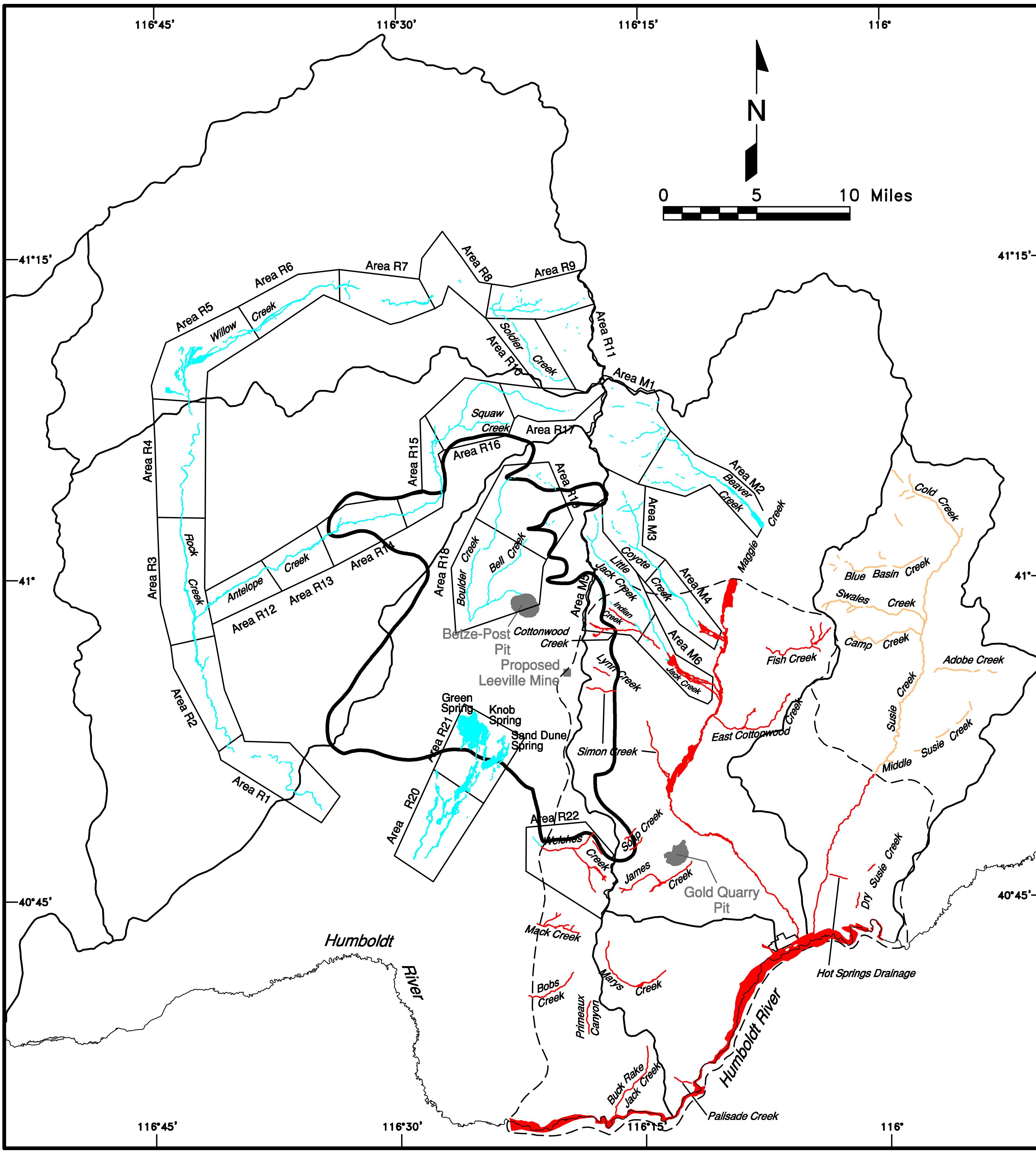

Legend

Ground Water Basin Boundary

Maximum Extent of 10-foot Drawdown Contour [1]

Riparian Inventory Areas [2,4]

South Operations Area Project-Study Area Boundary [3]

Riparian Area [3]

Riparian Area [4]

Riparian Area [5]

Notes:
1 See text in Section 3.2.2.1 for explanation
2 See Table 3.3-1
3 Source: BLM 1993b; JBR 1993
4 Source: Whitehorse Associates 1995a,b
5 Source: Newmont Gold Company (perennial reaches - riparian areas have not been inventoried)

Figure 3.3-1

Riparian Areas in the Hydrologic Study Area

Table 3.3-2
Wetland and Riparian Vegetation Types and Dominant Species in the Study Area

Vegetation Type	Site	Dominant Species[1]
Streambar	Above streamside type on stream deposits below ordinary high water mark (OHWM)	Annual muhly (*Muhlenbergia minutissima*), rabbitfootgrass (*Polypogon monspeliensis*), American bulrush (*Scirpus americanus*), coyote willow (*Salix exigua*), silverweed cinquefoil (*Potentilla anserina*), exalted centaury (*Centaurian exaltatum*), Canada horseweed (*Conyza canadensis*)
Herbaceous Streambar[2]	In or immediately adjacent to streams at or below OHWM or within channel or adjacent to stream below OHWM; in low lying oxbows, meanders, and sloughs with standing water or high groundwater throughout or late into the growing season; older relatively, dry meanders and upland terraces.	Fewflowered spikerush (*Eleocharis pauciflora*), American bulrush (*Scirpus americanus*), annual muhly (*Muhlenbergia minutissima*), American speedwell (*Veronica americana*), Kentucky bluegrass (*Poa pratensis*), Baltic rush (*Juncus balticus*), povertyweed (*Iva axillaris*), rabbitfootgrass (*Polypogon monspeliensis*), Canada cocklebur (*Xanthium strumarium*), inland saltgrass (*Distichlis spicata*), fivehook bassia (*Bassia hyssopifolia*), whitetop (*Cardaria draba*), black greasewood (*Sarcobatus vermiculatus*), reed canarygrass (*Phalaris arundinacea*), seepweed (*Suaeda* spp.)
Wet Meadow[3]	Within perennial streams or artesian seeps and springs in broad floodplains; ponds formed in deeper oxbows, meanders, borrow pits, or other depressions.	Cattail (*Typha latifolia*), hardstem bulrush (*Scirpus acutus*), American bulrush (*Scirpus americanus*), Nebraska sedge (*Carex nebraskensis*), Baltic rush (*Scirpus balticus*), woolly sedge (*Carex lanuginosa*), fowl bluegrass (*Poa palustris*), western mountain aster (*Aster occidentalis*), annual muhly (*Muhlenbergia minutissima*), slim sedge (*Carex praegracilis*), redtop bentgrass (*Agrostis stolonifera*), common yarrow (*Achillea millefolium*), Kentucky bluegrass (*Poa pratensis*), silverweed cinquefoil (*Potentilla anserina*), potentilla (*Potentilla gracilis*), and submerged or floating aquatics in open water
Salix Streambar[4]	Seasonally flooded levees and channels; recently exposed stream-laid deposits, moist to wet soils lining channel banks, newer oxbows and meanders; older stream-laid deposits and older oxbows and meanders and irrigation ditches.	Coyote willow (*Salix exigua*), cheatgrass (*Bromus tectorum*), false yarrow (*Chaenactis douglasii*), hairy willow-herb (*Epilobium cilitatum*), Scotch cotton-thistle (*Onopardum acanthium*), ragweed (*Ambrosis* spp.), rabbitfootgrass (*Polypogon monspeliensis*), Woods rose (*Rosa woodsii*), reed canarygrass (*Phalaris arundinacea*), common reed (*Phragmites australis*), and white sweetclover (*Melilotus alba*)
Salix/Wet Meadow	Seasonally flooded, saturated, or semipermantly flooded wetland	Pacific willow (*Salix lasiandra*), American mannagrass (*Glyceria grandis*), marsh yellow-cress (*Rorripa islandica*)
Salix/Mesic Meadow[5,8]	Banks adjacent to streams or in areas of high water table; moist, subirrigated low areas.	Yellow willow (*Salix lutea*), Kentucky bluegrass (*Poa pratensis*), Douglas sedge (*Carex douglasii*), western mountain aster (*Aster occidentalis*), coyote willow (*Salix exigua*), catchweed bedstraw (*Galium aparine*), Canada thistle (*Cirsium arvense*), fewflowered spikerush (*Eleocharis pauciflora*), creeping wildrye (*Elymus tritichoides*), common yarrow (*Achillea millefolium*), annual muhly (*Muhlenbergia minutissima*), fowl bluegrass (*Poa palustris*), narrowleaf cottonwood (*Populus angustifolia*), black cottonwood (*Populus balsamifera trichocarpa*), and Popular (*Populus* spp.)

Table 3.3-2 (Continued)
Wetland and Riparian Vegetation Types and Dominant Species in the Study Area

Vegetation Type	Site	Dominant Species[1]
Salexi/Mesic Meadow	Intermittently or seasonally flooded channels and levees	Coyote willow (*Salix exigua*), Nebraska sedge (*Carex nebraskensis*), Kentucky bluegrass (*Poa pratensis*), water groundsel (*Senecio hydrophilus*), field mint (*Mentha arvense*)
ALNINC/Mesic Meadow	Seasonally flooded wetland	Pacific willow (*Salix lasiandra*), Booth's willow (*Salix boothii*), slender hairgrass (*Deschampsia elongata*), Kentucky bluegrass (*Poa pratensis*), stinging nettle (*Urtica dioca*), curly dock (*Rumex crispus*), Oregon checker-mallow (*Sidalcea oregana*)

[1]Sources: Whitehorse Associates 1995a, b; BLM 1993b.
[2]Includes Gravel Bar and Bulrush/Cattail and saltgrass vegetation types as described in BLM 1993b.
[3]Includes Cattail/Pond, Sedge Meadow, Baltic Rush Meadow, and Grassy Wet Meadow/Grassy Meadow and Open Water vegetation types as described in BLM 1993b.
[4]Includes Yellow Willow and Coyote Willow thicket and poplar vegetation types as described in BLM 1993b.
[5]Includes Young and Mature Willow as described in BLM 1993b.

80 percent), good (81 to 90 percent), and excellent (91 to 100 percent). Riparian condition was based on channel morphology, which directly affects hydrologic attributes and associated riparian vegetation types. Riparian habitat inventories and the identified conditions for specific streams within these basins are described in the following sections.

Maggie Creek Watershed

Riparian habitat inventories were conducted along Beaver, Coyote, Little Jack, and Jack creeks by Whitehorse Associates in 1995 and along Spring, Jack, lower Maggie, James, Soap, Marys, Lynn/Simon, Bobs, Mack, Cottonwood, East Cottonwood, Fish, and Indian creeks by JBR in 1993 (Whitehorse Associates 1995a, b; JBR 1993). Approximately 46 percent (928 acres) of the riparian habitat present within the watershed occurs along Maggie Creek. Other creeks within the watershed that support substantial riparian habitat include Beaver Creek (323 acres), Coyote/Spring Creeks (314 acres), and Little Jack/Jack Creeks (367 acres). Wet meadow is the predominant riparian vegetation type within this watershed. The average riparian condition within this watershed was classified as poor (53 percent) (Whitehorse Associates 1995a, b). Riparian habitat conditions associated with Beaver (58 percent), Coyote (53 percent), and Jack creeks (50 percent) was classified as poor.

As part of the Mitigation Plan for the development of the SOAP, Newmont Gold Company, in conjunction with the Elko BLM and Elko Land and Livestock Company, developed the MCWRP to improve streams, riparian habitats, and watershed conditions within the Maggie Creek subbasin (BLM 1993b). The MCWRP was designed to enhance 1,982 acres of riparian habitat, over 40,000 acres of upland watershed, and 82 miles of stream channel within the Maggie Creek subbasin (BLM 1993b). Components of the plan included exclosure and pasture fencing for livestock grazing management, conservation easements, water developments, water augmentation, riparian plantings, and other measures. Restoration of Lahontan cutthroat trout (LCT) habitat was a key consideration in development of the plan.

The MCWRP includes the management and monitoring of stream and riparian habitats associated with Maggie, Coyote, Indian Jack, Little Jack, Lynn, and Simon creeks. An additional 23 spring sites also were fenced and developed where possible to provide alternate sources of water for livestock. Streams and associated riparian habitats are included within 16 pastures (see Figure 3.7-3 in Section 3.7). Changes in grazing management on these areas has included total exclusion of livestock; exclusion of livestock until selected biological standards have been met followed by limited, prescription grazing; and application of various grazing systems. Additional pastures controlled by Maggie Creek Ranch were initially identified for improvement in the MCWRP; however, no changes in management of these areas is known to have occurred.

Since the MCWRP was implemented in 1993, improvement of riparian habitat including streams occupied by LCT has been excellent (BLM 1997a, 1999). Streams that were once characterized by eroding streambanks and a wide, shallow channel profile now support healthy functioning riparian zones and stable, well vegetated streambanks. Where biological criteria have been established for the reintroduction of grazing, standards have been met, and grazing has been applied on a prescription basis since 1997.

Rock Creek Watershed

Riparian habitat inventories were conducted along Rock, Willow, Antelope, Boulder, and Welches creeks by Whitehorse Associates in 1995 (Whitehorse Associates 1995a, b). In addition, riparian/wetland habitats associated with Green, Knob, and Sand Dune springs located in Boulder Valley also were delineated. Approximately 89 percent (1,494 acres) of the riparian vegetation present within this watershed was observed along Rock (473 acres), Willow (635 acres), and Antelope creeks (386 acres). Herbaceous streambar is the predominant riparian vegetation type that occurs in this watershed. The average riparian condition within this watershed was classified as very poor (48 percent). Riparian habitat conditions associated with Antelope (35 percent), Boulder (29 percent), Rock (47 percent), Welches (46 percent), and

Willow creeks (69 percent) were classified as very poor to fair (Whitehorse Associates 1995a, b).

Riparian surveys also were conducted in numerous Rock Creek tributaries in 1994 and 1997 (BLM 1998c). The surveys indicated that riparian condition class was excellent in Frazer Creek within the BLM exclosures; fair in Frazer Creek below the BLM exclosures, upper Toe Jam Creek, and upper Rock Creek; and poor in lower Toe Jam Creek and upper Willow Creek. The condition class was based on the percent of bank cover and stability. The percent bank cover ranged from 42 to 50 percent of optimum growth for Toe Jam, Frazer (below BLM exclosures), upper Rock, and upper Willow creeks. Riparian bank cover in the Frazer Creek BLM exclosure area was 90 percent of optimum.

<u>Susie Creek Watershed</u>

Riparian habitat inventories were conducted along lower Susie Creek and the Hot Springs drainage by JBR in 1993 (JBR 1993). Figure 3.3-1 illustrates the perennial stream reaches that have not been inventoried, including the upper portion of Susie Creek and associated tributaries. Susie Creek supports approximately 89 percent (204 acres) of the riparian habitat observed within the watershed. Streambar is the predominant riparian vegetation type that occurs in this watershed. The condition of riparian habitat within this watershed is considered good to excellent in over 9 miles of the lower reaches. Riparian quality is considered degraded on private lands located upstream.

<u>Small Tributaries to the Humboldt River</u>

Riparian habitat inventories along small tributaries to the Humboldt River (i.e., Primeaux, Palisade, Buck Rake Jack, and Dry Susie creeks) were conducted by JBR in 1993 (JBR 1993; BLM 1993b). Approximately 5 and 4 acres of riparian habitat were observed along Buck Rake Jack and Dry Susie creeks, respectively. Primeaux and Palisade creeks support approximately 2 acres of riparian vegetation. Herbaceous streambar is the predominant riparian vegetation type that occurs in this area. The condition of riparian habitat within this area is unknown.

<u>Humboldt River</u>

A riparian habitat inventory was conducted along the Humboldt River by JBR in 1993 (JBR 1993; BLM 1993b). Approximately 388 acres of riparian vegetation were observed along the Humboldt River. Salix streambar is the predominant riparian vegetation type (242 acres) that occurs along the Humboldt River. The condition of riparian habitat is unknown.

Based on a series of field investigations, all springs and seeps identified in the study area are illustrated in Figure 3.2-9 (JBR 1990a; RTi 1994; JBR 1992b; Newmont 1999c). These springs and seeps are primarily associated with perennial streams in the study area and support wetland species commonly associated with riparian areas.

<u>Goldstrike Mine Area</u>

Representative seeps and springs also have been sampled for a number of years in the Goldstrike Mine vicinity to determine whether or not dewatering activities are affecting flows. As part of the monitoring effort, vegetation transects were established in 1993 at several of the sampling sites to assess annual variations in the vegetative structure and species composition of the springs and seeps within the project area (Keammerer 1998). Eight transects at spring, seep, and creek bottom sites located east and west of the Betze Pit have been sampled annually since 1993, and eight additional transects were established in 1995 north and west of the Betze Pit. Table 3.3-3 lists the types of dominant vegetation associated with each transect and notes regarding grazing impacts on existing vegetation. The optimum areas for evaluating potential effects are transects located in seep areas that are not grazed (Keammerer 1997). In 1993, 66 species were observed, compared with 77 species in 1997 and 1998 (Keammerer 1998). Differences in overall species composition have been minor and are most likely not related to mining activities, but rather to grazing intensity, yearly precipitation variations, and differences related to field observations (Keammerer 1998). At most sites, no changes related to dewatering have been observed over the 5-year sampling period; one exception is a site on Brush Creek where flows and vegetation have been affected by dewatering activities.

Table 3.3-3
Vegetation Associated with Seeps and Springs

Dominant Plant Species in Vegetation Transects Sampled Since 1993	Documented Grazing Influences
Cocklebur (*Xanthium strumarium)*, cheatgrass (*Bromus tectorum)*	None noted
Alkali bluegrass (*Poa juncifolia*), alkali cordgrass (S*partina gracilis*), alkali muhly (*Muhlenbergia asperifolia)*	None noted
Red top (*Agrostis alba)*, Kentucky bluegrass (*Poa pratensis),* Nebraska sedge (*Carex nebraskensis*), common spikerush (*Eleocharis* sp.),	Grazed previously[1]
Three-stamen rush (*Juncus ensifolius)*, Nebraska sedge	Ungrazed until 1998
Kentucky bluegrass, dandelion (*Taraxacum officinale)*, red top	Heavily grazed[1]
Meadow barley (*Hordeum brachyantherum*), bacopa (*Bacopa rotundifolia)*, Kentucky bluegrass	Heavily grazed[1]
Red top, bacopa	Grazed[1]
Meadow barley	Grazed[1]
Dominant Plant Species in Vegetation Transects Sampled Since 1995	
Chairmaker's rush (*Scirpus americanus)*, alkali muhly, scouring rush	Ungrazed
Chairmaker's rush, strawberry clover (*Trifolium fragiferum*) horsetail (*Equisetum laevigatum)*	Heavily grazed[1]
Baltic rush, dandelion	Grazed[1]
Chairmaker's rush, Baltic rush	Grazed in some years[1]
Nebraska sedge	Heavily grazed[1]
Sedge (*Carex* spp.), common spikerush, Nebraska sedge	Grazed
Baltic rush, common spikerush	Grazed
Mat muhly (*Muhlenbergia richardsonis)*, red top, Kentucky bluegrass	Grazed[1]

Source: Keammerer 1998, as appended to Adrian Brown Consultants, Inc. 1998.
[1]Year-to-year differences in vegetative cover are likely related to cattle grazing.

Following the appearance of the three springs (i.e., Green, Knob, and Sand Dune springs) in Boulder Valley, wetland vegetation developed in the areas of standing water (see areas R20 and R21 in Figure 3.3-1). In 1995, the Sand Dune drainage area included approximately 885 acres of riparian vegetation primarily consisting of cattails (*Typha latifolia*) and 80 acres of desert saltgrass (*Distichlis stricta*) (Woodward-Clyde 1996). At the time of the study, approximately 1,935 acres were covered with standing water. This area was described as 2,819 acres of Marsh and Transition to Marsh vegetation in the Whitehorse study (Whitehorse Associates 1995a, b). The mounding of water in upper Boulder Valley is predicted to gradually subside and dissipate. As water levels subside, the wetland vegetation would decline and likely be replaced by uplands dominated by salt-tolerant species.

3.3.1.2 Humboldt River Study Area

Riparian habitat associated with the Humboldt River supports various riparian vegetation types including willow, cottonwood, bulrush, cattail, saltgrass, and stream deposits (Rawlings and Neel 1989). The majority of riparian vegetation occurs in areas with numerous meanders and oxbows. The riparian habitat survey conducted by Rawlings and Neel (1989) included the Humboldt River and its major tributaries from the Deeth area (approximately 32 miles northeast of Elko) to Rye Patch Reservoir (204 miles). The 53-mile portion of the river that extends from the Dunphy discharge point to the Comus gaging station supports approximately 8,618 acres of riparian vegetation and includes:

- Willow – 2,311 acres;
- Cottonwood – 16 acres;
- Bulrush – 2,810 acres;
- Cattail – 330 acres;
- Saltgrass – 2,410 acres; and
- Stream deposits – 741 acres.

Willow stands typically occur in recent to old stream-laid deposits, moist to wet soils lining channels, oxbows, meanders, and irrigation ditches. This vegetation type is characterized by a dominant shrub layer consisting of coyote willow and Wood's rose and a subdominant layer of herbaceous species dominated by rabbitsfoot-grass (*Polypogon monspeliensis*), reed canary-grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), cheatgrass (*Bromus tectorum*), and ragweed species (*Ambrosia* sp.). Some of the willow stands include minor populations of tamarisk (*Tamarix ramosissima*), which is considered an invader species. Cottonwood stands are associated with moist, subirrigated low areas that are dominated by narrowleaf cottonwood (*Populus angustifolia*) and black cottonwood (*Populus trichocarpa*) trees and an understory consisting of upland herbaceous species.

Bulrush communities are established in low-lying oxbows, meanders, and sloughs with high ground water late into the growing season. Plant species commonly associated with this vegetation type include various bulrushes, rushes, and sedges. Cattail communities also occur in low-lying oxbows, and meanders and sloughs with standing water or high ground water throughout the growing season. Species that are commonly associated with these communities include common cattail, bulrushes, and rushes. Saltgrass communities are established on older, relatively dry meanders and upland terraces and typically support inland saltgrass, black greasewood (*Sarcobatus vermiculatus*), reed canary-grass, and seepweed (*Suaeda* sp.).

Stream deposits occur along seasonally exposed stream-laid deposits within or adjacent to active channels. These areas are typically devoid of vegetation or sparsely vegetated with annual weed species or young willows.

The Nevada Division of Wildlife (NDOW) conducted riparian habitat studies at eight sites along this segment of the Humboldt River (Bradley and Neel 1990; Bradley 1992; and Neel 1994). The condition of these sites ranged from poor to excellent including three sites in poor condition; two sites in fair or fair to good condition; two sites in good condition; and one site in excellent condition. Riparian areas in poor condition were characterized by low plant cover, especially willows, and typically support minimal riparian vegetation resulting from flooding or overgrazing. The site in excellent condition was characterized by above average plant cover provided by willows and was located in the Herrin Slough area.

The Humboldt River extends approximately 141 miles from the Comus gaging station to the Humboldt Sink; 21 miles of the river is impounded to form Rye Patch Reservoir. The upper segment of the river extends approximately 71 miles from the Comus gaging station to Rye Patch Reservoir, and the lower segment extends approximately 49 miles from the Rye Patch Reservoir Dam to the Humboldt and Carson sinks.

Riparian habitat studies were conducted by NDOW at eight sites along the segment of the Humboldt River extending from the Comus gaging station to Rye Patch Reservoir (Neel 1994). The condition of these sites ranged from poor to good including one site in poor condition and seven sites in good condition. Poor condition in the riparian area was characterized by low plant cover; especially by willows, and supported minimal riparian vegetation resulting from flooding or overgrazing. The seven sites in good condition were characterized by extensive willow and bulrush communities associated with meanders and oxbows.

Based on riparian habitat studies conducted by the NDOW, a net loss of 13.4 miles of river length between Dunphy and Rye Patch Reservoir has occurred during the past 30 years. Substantial loss of river length and sinuosity has occurred in the Dunphy and Argenta area, and downstream to Winnemucca. In other locations, such as near Comus and Winnemucca, the river has both increased and decreased its length.

Prior to the 1950s, a large wetland complex named the Big Slough existed along the Humboldt River approximately halfway between Battle Mountain and Dunphy. This complex consisted of wetlands and abandoned channels that supported extensive stands of willow and other riparian and wetland vegetation. During the 1950s, this area was drained by a Federal channelization project, which straightened the course of the river for several miles through the Argenta vicinity and elsewhere along the river. This area is currently referred to as the former Argenta Marsh and primarily supports upland species. NDOW and other public and private organizations are interested in restoration of the former Argenta Marsh with the use of mine discharge water in the river (see Section 3.2.1.3). The majority of the riparian/wetland vegetation associated with Rye Patch Reservoir is located where the river enters the reservoir. Riparian plant species established in this area primarily include willows and tamarisks. Riparian vegetation is limited along the remainder of the reservoir shoreline due to the deep water near the shoreline, fluctuating water levels, and steep banks. Narrow bands of riparian vegetation, primarily consisting of willows, are established along the shorelines of Upper and Lower Pitt-Taylor reservoirs.

The segment of the Humboldt River extending from Rye Patch Reservoir to the Humboldt Sink is characterized by a well-defined, deeply incised river channel with low channel sinuosity, which supports narrow, localized bands of riparian vegetation established along the river bank or sandbars. The river channel and the associated extent of riparian vegetation within the floodplain in the Lovelock area is narrower as a result of various water diversions.

Prior to agricultural development in the region, most of the water of the Humboldt River flowed unrestricted to the Humboldt Sink wetlands. At the end of the 19th century the Humboldt Sink supported approximately 58,000 acres of wetland vegetation (Seiler et al. 1993). Wetlands were extensive, and the lower valley was a large meadow (Big Meadow). The most common plants in the wetlands included alkali bulrush (*Scripus paludosus*), cattails, sago pondweed (*Potamogeton pectinatus*), and muskgrass (*Chara* sp.). Dikes were built along the lower Humboldt River, and wetlands were drained for crops. The area formerly known as the Big Meadow became the Lower Valley agricultural area (Seiler et al. 1993). Between 1949 and 1973, wetlands within the Humboldt Wildlife Management Area (HWMA) covered only 12,850 acres, or 22 percent of its original size (Hallock et al. 1981).

Three wetlands units occur in the HWMA including the Upper Humboldt Lake, Lower Humboldt Lake, and Toulon Lake. Water depth in the Upper and Lower Humboldt lakes typically ranges from 2 to 18 inches; approximate water depth during the 1880s was estimated at 12 feet. Toulon Lake is approximately 4 feet higher than Humboldt Lake and is not directly fed by the Humboldt River. Prior to agricultural development in the Lovelock area, Toulon Lake was intermittently filled by spillover from the Humboldt Lakes (Seiler et al. 1993). During the 1930s and 1940s, prior to the completion of the Toulon Drain, Toulon Lake was an alkali playa.

The Carson Sink is an alkaline playa lake that supports limited wetland vegetation. The high salinity in the water makes it intolerable for most plants except salt-tolerant plants, including seepweed and desert saltgrass.

3.3.2 Environmental Consequences

3.3.2.1 Impacts from Mine Dewatering and Localized Water Management Activities

The potential for impacts to riparian areas is based on the (1) predicted ground water drawdown and (2) the connectivity of the perennial streams, seeps, and springs supporting riparian vegetation with the regional ground water aquifer (see Section 3.2.2.1, Impacts to Perennial Springs and Streams).

Ground water model simulations suggest that reductions in baseflow could occur in Antelope and Boulder creeks, and tributaries to Maggie Creek (see Section 3.2.2.1). However, because of the limitations inherent in hydrologic modeling and the uncertainty regarding the hydrologic interconnection between the streams and the regional ground water system, the actual extent and magnitude of impacts to riparian vegetation are uncertain.

Figure 3.3-2 illustrates the riparian areas that potentially could be affected by ground water drawdown associated with ground water pumping for Goldstrike Mine dewatering. The riparian areas within the shaded area in Figure 3.3-2 are located in areas where perennial waters potentially could be impacted by drawdown; therefore, the potential exists for impacts to some of the associated riparian areas. Other riparian vegetation areas within the 10-foot drawdown area are unlikely to be affected by ground water drawdown (see Section 3.2.2.1). Approximately 137 acres (22 percent) of the 621 acres of riparian vegetation within the predicted 10-foot drawdown area occur within the areas where perennial waters could be affected by ground water drawdown (see Figure 3.3-2). The remaining 484 acres of riparian vegetation occur outside of these areas and are considered less likely to be affected by ground water drawdown. The following sections provide specific information regarding riparian vegetation that potentially could be affected by ground water drawdown by individual watersheds.

Drawdown could reduce the baseflow of perennial creeks within the area. Exposed channel sediments during reduced baseflow periods would be prone to invasion by noxious weeds. Noxious weed species, including Scotch thistle, Canada thistle, leafy spurge, whitetop, water hemlock, diffuse knapweed, and Russian knapweed, could become established within these channels (BLM 2000a). Riparian vegetation would likely dominate these areas after water levels returned to premine conditions.

Rock Creek Watershed

Approximately 136 acres of riparian vegetation associated with Boulder, Bell, and Welches creeks could be affected by ground water drawdown associated with the Goldstrike Mine. The majority of the riparian vegetation (135 acres) that could be affected is associated with Boulder and Bell creeks; approximately 1 acre of riparian vegetation is associated with Welches creek. As stated in Section 3.2.2.1, ground water drawdown could extend to within 1 to 2 miles of perennial reaches located in the upper Antelope Creek watershed. In addition, some discontinuous stream segments (located downstream from the perennial reaches) are located within the projected drawdown area. Considering the uncertainty of the long-term drawdown predictions, future drawdown potentially could impact riparian vegetation along these stream segments. Riparian vegetation present along lower Rock Creek is located several miles outside of the predicted 10-foot drawdown area and is unlikely to be affected by drawdown (see Section 3.2.2.1).

Maggie Creek Watershed

One acre of riparian vegetation associated with Soap Creek could be affected by ground water drawdown associated with the Goldstrike Mine. Riparian vegetation (38 acres) associated with Cottonwood, Lynn, and Simons creeks is unlikely to be affected by ground water drawdown.

Isolated Springs and Seeps

Approximately 44 isolated springs and seeps, that are not associated with perennial stream reaches, occur within areas where perennial waters could be impacted by drawdown (see Figure 3.2-9). Based on the SOAPA Draft EIS (BLM 2000a) and the 1993 SOAP EIS (BLM 1993b), the majority of wetlands observed within the Maggie Creek basin range from 0.1 acre to 1.0 acre in size. Assuming that each spring supports an average of 0.3 acre of wetland vegetation, an estimated 13 acres of wetland vegetation occur within areas where perennial waters could be impacted.

In summary, according to ground water modeling and associated water resources analyses, approximately 137 acres of riparian vegetation associated with perennial stream reaches and 13 acres of wetland vegetation associated with isolated seeps and springs are located within areas where some reduction in flow could occur. Therefore, 150 acres of riparian/wetland vegetation within these areas potentially could be affected by ground water drawdown for the Goldstrike Mine.

3.3.2.2 Impacts to the Humboldt River

Natural fluctuations in water levels caused by seasonal variations and flood and drought events

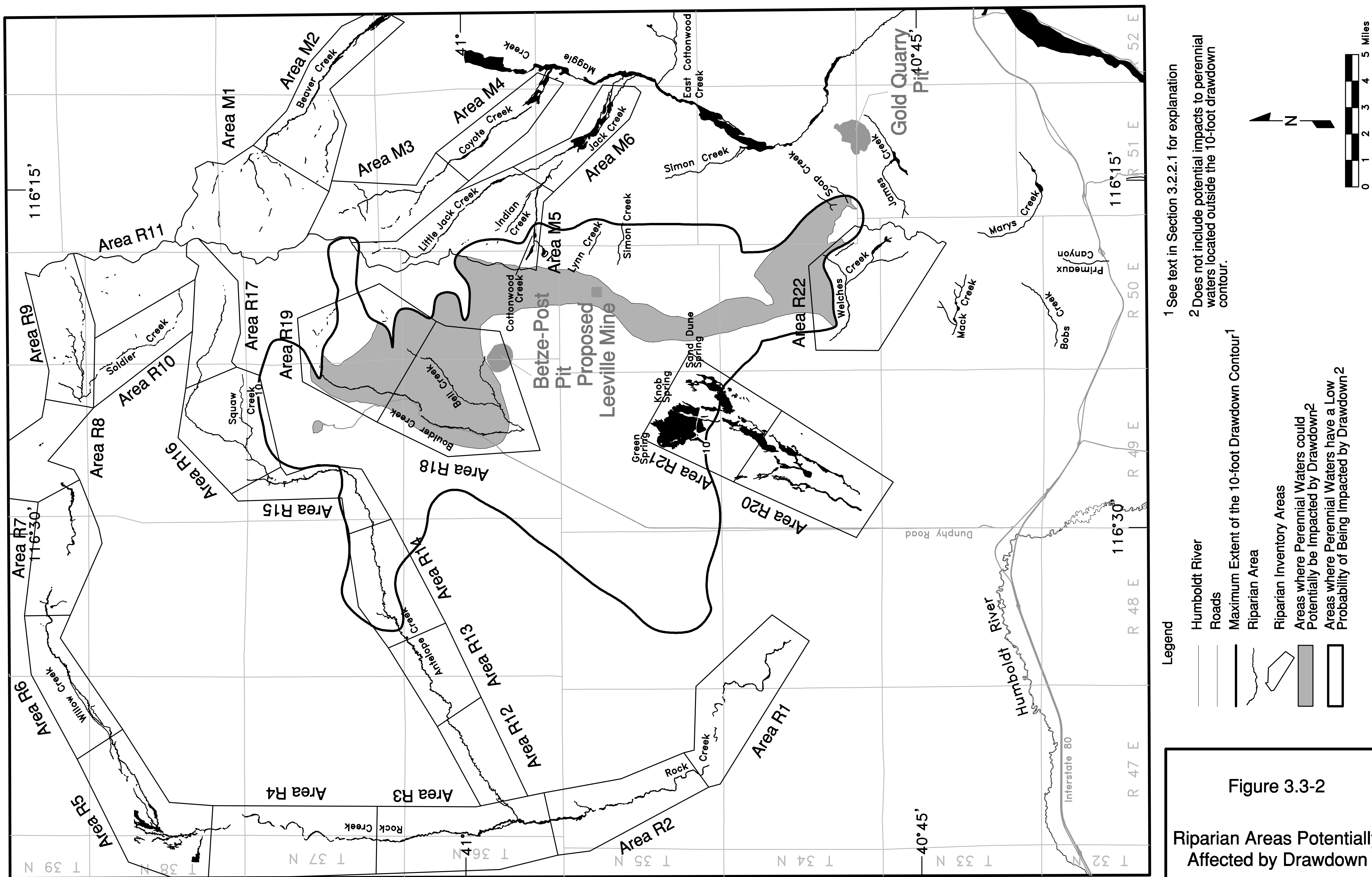

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Figure 3.3-2

Riparian Areas Potentially Affected by Drawdown greatly influence the distribution and extent of riparian vegetation established within the Humboldt River floodplain. As described in Section 3.2.2.2, Barrick's discharges would temporarily increase flows in the Humboldt River. Increased water levels potentially could affect channel configuration, depth, and sinuosity that directly affect the distribution and extent of riparian vegetation.

In general, the peak Humboldt River flow months (i.e., May and June) would not be affected by additional Goldstrike Mine discharge. Relative to the natural fluctuations in river flows during these months, the increases would be small and would have no impact to the flow regime of the Humboldt River during average peak flow months. Water discharges into the river could result in a minimal increase during low-flow periods. During low-flow periods (September to November), the average water depth could increase approximately 1.2 feet (0.8 to 1.6 feet), and channel width could increase approximately 38 feet under the maximum Goldstrike Mine discharge scenario.

Effects from increased water levels during baseflow periods include an increase in elevated water table in low-lying areas located adjacent to the river, increasing the frequency of flooding of stream meanders and oxbows. Riparian/wetland plants could become established in areas where the water table is elevated to the rooting depths needed for riparian/wetland plant establishment. Stream meanders and oxbows could be more frequently subjected to flood events, further enhancing the potential for riparian/wetland plant establishment. Increased baseflows and slightly increased peak flows could facilitate the establishment of willows along the main river channel and side channels since the water levels would be more constant throughout the year. Increases in the extent of riparian vegetation would be most noticeable along segments of the river with gradual banks and low-lying areas located adjacent to the river. These areas could be more frequently flooded during peak flows, and the water table could be shallow due to increased baseflows.

An additional effect resulting from increased water levels during low-flow periods would be the potential for restoring or enhancing specific wetland and marsh habitats in Herrin Slough. Riparian/wetland areas currently present in Herrin Slough, which consists of a series of low-gradient channels, could be enhanced by increased baseflows and slightly elevated peak flows. Water levels in Upper and Lower Pitt-Taylor Reservoirs could become more consistent, which would improve conditions for wetland and aquatic plant establishment.

Additional effects may include channel instability in the reach extending approximately 3 miles upstream and downstream from the Barrick outfall, deepening of the river channel, and loss of streamside riparian vegetation due to increased erosion and destabilization of stream banks.

Small, isolated stands of wetland vegetation that occur along the banks of Rye Patch Reservoir would likely be lost if water levels were consistently high within the reservoir during periods of high water discharge. As a result of consistently high water levels, wetland vegetation could be lost to inundation. Steep banks immediately adjacent to the reservoir would make it difficult for wetland vegetation to become re-established. Wetland vegetation would not become established until water levels were comparable to pre-discharge water levels.

Depending on irrigation withdrawals and returns during the period of discharges, the areal extent of wetland vegetation within the Humboldt Sink could increase as a result of higher and more consistent water levels. Consistent high water levels in the Humboldt Sink could flood and kill stands of salt cedar. Portions of the sink that were seasonally flooded would likely be perennially inundated, resulting in the temporary loss of emergent wetland vegetation until it becomes established along the margins of the sink. Dense stands of salt cedar could become re-established on exposed sediments during low-water periods. Increased water levels also would increase the extent of open water habitats that would facilitate aquatic plant establishment. These effects would subside when mine discharges cease. Excess water from the Humboldt Sink may occasionally reach the Carson Sink during high-water periods. The Carson Sink is a shallow, highly alkaline playa lake that primarily supports salt-tolerant upland species. However, the occasional influx of water conveyed to the Carson Sink would not result in the establishment of wetland plants.

3.3.3 Monitoring and Mitigation

Based on the mitigation measures associated with the Betze Project Record of Decision (BLM 1991d), Barrick has funded mitigation of riparian and wetland areas potentially affected by dewatering of the Betze Pit (Betze Project Record of Decision, Exhibit C, Conservation and Mitigation of Riparian/Wetland Areas [BLM 1991d]). Barrick was obligated to contribute $660,000 to mitigate for the potential loss of riparian vegetation. Barrick also is committed to conduct long-term surface water monitoring activities (BLM 1991d).

If further reduction of surface waters were identified during the existing long-term surface water monitoring programs (see Section 3.2.3), Barrick would coordinate with the BLM to develop feasible water augmentation or improvement measures for affected springs or perennial stream reaches. This measure could include either on-site or off-site guzzler placements, small water pipelines, livestock fencing around existing surface water sources, etc. The feasibility of these options would be discussed relative to the riparian or wetland habitat value in the long term.

To provide off-site riparian or wetland habitat, Barrick would coordinate with the BLM to implement specific changes in the land use of the Squaw Valley Allotment. The specific components of this measure would be discussed among the BLM, Barrick, and the lessee, and appropriate improvement measures would be implemented on Barrick's property.

3.3.4 Residual Effects

Residual impacts to riparian vegetation would be avoided with the implementation of the monitoring and mitigation measures described in Section 3.3.3.

3.3.5 Irreversible and Irretrievable Commitment of Resources

Riparian and wetland vegetation affected by mine-induced drawdown would be irretrievably lost during the ground water recovery period. If ground water recovery occurs at spring locations and along creeks, the loss of riparian and wetland vegetation would be reversible; if riparian and wetland vegetation does not recover, the loss at these locations would be irreversible. However, offsite mitigation would compensate for these losses.

3.4 Terrestrial Wildlife

3.4.1 Affected Environment

3.4.1.1 Habitat

The study area for both the direct and cumulative impact analyses for terrestrial wildlife is composed of the cumulative assessment area described in Section 3.2.1, Water Resources and Geochemistry, Affected Environment. Representative species' lists and additional descriptions of terrestrial habitats associated with the study area and along the Humboldt River can be reviewed in a number of sources, including the Betze Project Draft EIS (BLM 1991a); BLM (1992, 1993b, 1996a); Bradley (1992); Neel (1994); Bradley and Neel (1990); Rawlings and Neel (1989); JBR (1990b, 1992a, b, g); Fox (1993), and ENSR (1995).

Dewatering and Localized Water Management Area

These studies have documented a diversity of wildlife resources that occupy the native upland sagebrush habitat, seeps and springs, perennial riparian areas, and modified habitats (e.g., agricultural lands, man-made wetlands, reclaimed communities, seeded grassland, burned areas, mining zones). The vegetation types or communities that comprise the primary wildlife habitats in the study area include upland sagebrush, juniper ridgelines, seeded grassland, and limited riparian habitats. The riparian habitat associated with wetlands, springs, and perennial stream channels is considered the highest value habitat for area wildlife. Available water for wildlife consumption and riparian vegetation for cover, breeding, and foraging are the predominant limiting factors for wildlife resources in northern Nevada. Therefore, riparian habitats, particularly those with multistoried canopies and open (free) water, typically support a greater diversity and population density of wildlife than the drier, upland habitats.

Surface water sources potentially available to wildlife are described in Section 3.2.1. The riparian habitats range from the limited lower-elevational wetlands, stock ponds, or isolated springs that are primarily composed of small, narrow drainages or moist soils with scattered patches of emergent vegetation to the higher-elevational springs that maintain a greater-value riparian habitat for wildlife use (JBR 1990a, b, 1992a, b) (see Section 3.3, Riparian Vegetation). The higher elevations of the Tuscarora Mountains, Independence Mountains, and, to a lesser extent, the Sheep Creek Range and Adobe Range support a variety of species that differ substantially from those generally found at the lower elevational water sources in the surrounding basins. Important habitat characteristics for both aquatic and terrestrial wildlife include the amount of open water; the extent of both herbaceous and woody vegetation, which is used for cover, foraging, and breeding activities; the quality of these plant communities, relative to the long-term use by wildlife (i.e., community longevity); and the diversity of plant species present.

Recent wildfire events in northern Nevada have seriously affected the native ranges for wildlife. These wildfires have resulted in decreased plant diversity and abundance, affecting the overall carrying capacity of the habitats and the wildlife that depends on them. Currently, the BLM is implementing reclamation and reseeding programs in conjunction with adjacent private landowners in order to improve range conditions and minimize cheatgrass invasions.

Humboldt River Basin

The Humboldt River is located within the largest watershed in Nevada. Habitats vary along the river corridor, ranging among wide floodplains, agricultural hay meadows, developed pastures, native willow and wild rose stands, natural sloughs, a limited number of trees, and steep cliff walls that intersect directly with the river. The diversity of wildlife species associated with these varied habitats along the river corridor has generally depended on the past settlement patterns, man-induced channelization projects, and land uses. As human populations along the basin have increased, vegetation modifications have resulted in associated changes to resident and migratory wildlife species. These activities have altered the overall landscape or the physical and biological character of the Humboldt system, thereby affecting the wildlife populations that depend on the floodplain and riparian habitats.

General habitat trends recorded along the Humboldt River indicate that some portions of the system have maintained overall ecological health, while others have deteriorated or the habitat conditions are currently in a downward trend (Bradley 1992; Neel 1994).

As with many river systems throughout the arid western United States, the Humboldt River supports a variety of wildlife species, ranging among waterfowl, shorebirds, small to large mammals, raptors, amphibians, and reptiles. Approximately 52 percent of the bird species recorded for the Humboldt River system were associated exclusively with the riparian habitat type, while only 3 percent of species observed were affiliated exclusively with upland communities (Rawlings and Neel 1989).

The Nevada Division of Wildlife (NDOW) initiated a program in 1983 to assess wildlife habitat values along the Humboldt River system floodplains and to measure, where feasible, the effects to those habitat values from human-related activities (Bradley 1992; Neel 1994). NDOW's wildlife and habitat studies extend downstream to Rye Patch Reservoir. Few data exist for the portion of the Humboldt River downstream of Rye Patch Reservoir to the Humboldt Sink. Wildlife surveys were designed to determine overall species' occurrence and habitat preferences. These survey results are detailed in Bradley (1992), Neel (1994), and Bradley and Neel (1990) and are summarized in Rawlings and Neel (1989).

Habitats along the Humboldt River can be broadly categorized as riparian-wetland or upland habitat types. The riparian-wetland habitat includes the willow, rose, bulrush, cattail, meadow, and cottonwood communities, in addition to the river channel and on-channel ponds. The upland habitat includes the saltgrass, wildrye, greasewood-rabbitbrush, upland shrub, and annual weed communities. The buffaloberry community is classified in a third, separate category because of its unique properties, as discussed below (Rawlings and Neel 1989). The type and availability of these plant communities are primary factors in determining overall wildlife distribution along the Humboldt River (Rawlings and Neel 1989; Bradley 1992; Neel 1994).

The descriptions for the Humboldt River system focus on the riparian-wetland habitat type, since available water and the riparian-wetland vegetation (which provide cover, forage, and breeding areas) are limiting factors for both resident and migratory wildlife in Nevada.

Willow communities are considered one of the most valuable wildlife habitats. The greatest diversity of wildlife species along the Humboldt River has been recorded within the willow community, particularly for bird species (Rawlings and Neel 1989). Willows provide both vertical and horizontal structure for breeding sites, escape cover, and thermal cover and are important to maintaining bank stability. Willows aid in maintaining and building floodplains, since they are a primary pioneering species that can become established on stream deposits following flood events. The capability of either directing or absorbing floodwaters is important in maintaining quality wildlife habitat, and some sections of the Humboldt River and its tributaries have lost much of their ability to store floodwaters. If willows were removed or inhibited from establishing along the riverbank, stream deposits may remain unvegetated and inherently unstable (Bradley 1992). Willow stands often support a mid-story of rose and currant, with an understory of bulrush, cattail, rushes, sedges, and meadow grasses. Because of the available cover, willows provide primary wildlife movement corridors along the river system.

Cottonwood communities are scattered along the river corridor. This community provides additional canopy structure for avian species, particularly during the breeding season. In some locations along the Humboldt River, heron rookeries occur in cottonwood trees (Bradley 1992).

Another community that is valuable to wildlife is dominated by buffaloberry. The majority of buffaloberry within the project region occurs in portions of Humboldt and Pershing counties. Buffaloberry exhibits characteristics of both the riparian-wetland and upland habitat types, resembling more of a riparian-wetland type, but typically occupying drier portions of the floodplain that generally support more upland plant species. Buffaloberry stands provide additional vertical structure and often support the higher-value, mid-, and understory species (e.g., wild rose, currant, and annual forbs), which supply a quality food source for wildlife (Neel 1994). A multi-storied buffaloberry stand also may approach the diversity of bird species recorded for the willow community (Rawlings and Neel 1989).

Subsequent to manipulations by humans for irrigation and livestock grazing, areas along the Humboldt River were converted to hay meadows. Vegetation composition within these meadows can vary, depending on soil moisture, ranging from wet meadows to drier, more upland areas. Wet hay meadows often provide marsh-like habitat, which generally receives more use from shorebirds, waterfowl, raptors, etc., than the drier meadows that are dominated by annual grasses found in the more upland sites. The wet meadows support the highest avian species diversity, second only to the willow community. These meadows provide critical foraging and nesting habitat for a number of species of waterfowl, shorebirds, passerines (i.e., songbirds), and raptors along the Humboldt River. Even higher species diversity has been recorded in wet meadow or buffaloberry communities interspersed with willow stands (Rawlings and Neel 1989).

As discussed in Section 3.2.1.3, the sinuosity of the Humboldt River varies dramatically from human-induced changes. A greater sinuosity typically equates to higher wildlife habitat values, species diversity (i.e., species richness or variety), biodiversity (i.e., a greater genetic diversity or variation relative to the structure and community composition), and species density (i.e., numbers of animals within an area).

Historically, wetland conditions were created by meander scars and old oxbows, which intersected with ground water and maintained open or available water for long periods of time. Currently, cattail, bulrush, and some willow stands are generally limited to the remaining meander scars and oxbows along the river channel. Ponded water in these areas provides important nesting, brooding, foraging, and resting habitat for other water-dependent species. Fish may become trapped during low-flow periods, providing increased prey availability for bird and mammal predators, such as mink, otter, great blue heron, bald eagle, etc. (Bradley 1992; Neel 1994).

The past changes to and channelization of the Humboldt River system that have occurred since settlement along the river corridor are described in Section 3.2.1.3. A net loss of 13.4 miles of river length has resulted, particularly in the Dunphy and Argenta areas, in addition to the river reach downstream of Winnemucca. The straightening of the river channel for the Humboldt Project, which was designed to deliver increased water flows to the Lovelock Valley for irrigation purposes, resulted in a reduction in channel sinuosity, thereby reducing the availability of wetland habitats, open water areas, and riparian vegetation typically associated with these habitat types. Further erosion also has resulted in increased channelization. As the floodplains are dewatered by increased channelization, vegetative changes occur, resulting in a loss of riparian vegetation; encroachment of drier, upland plants; and a greater propensity to flooding.

The Argenta Marsh was located near Battle Mountain. Historically, the marsh provided valuable habitat used by large numbers of migratory waterfowl, shorebirds, and passerines (Bradley 1998). In the 1950s, the Humboldt drainage was channelized to drain the marsh. The majority of the 2,600 acres of the bulrush community and an unknown amount of native hay and willow communities, which had been historically associated with the Argenta Marsh and Rock Creek, were lost during this channelization effort. The current habitat conditions of the marsh area and Rock Creek are more structured for upland wildlife species. Willow regeneration along Rock Creek is low to none from the willow eradication programs previously implemented along the channel, combined with the past and current livestock grazing pressure. These activities dramatically reduced the relative habitat value for wildlife species typically associated with the wetland communities along this river reach (Bradley 1992).

An area along the Humboldt River east, or upstream, of the Comus Gage near the Herrin Slough supports large stands of hardstem bulrush, dense willow stands, and sufficient woody and herbaceous understory plants to provide valuable cover, breeding sites, and forage for a wide diversity of wildlife species. The

Herrin Slough is an area of braided, low-gradient channels in the Humboldt River floodplain. Many of the wildlife species associated with this area (e.g., great blue heron, snowy egret, gadwall, Wilson's phalarope, Virginia rail, yellow warbler, black-headed grosbeak, lazuli bunting) are indicative of a healthy community along the Humboldt River corridor (Neel 1994). Beaver, river otter, and mountain lion were recorded in this area in 1988. Mountain lions are rare along the Humboldt River because of the lack of adequate cover along a majority of the river corridor. This area upstream of the Comus Gage and northwest of Valmy likely represents one of the few river reaches capable of supporting a mountain lion for any extended period of time (Neel 1994).

Immediately downstream of the Comus Gage near Golconda, extensive bulrush-cattail communities support a high diversity of wildlife species. River channel meanders and oxbows are still present and dense willow stands occur along the river channel, contributing increased breeding sites, cover, and foraging potential for wildlife (Neel 1994).

Rye Patch Reservoir provides limited habitat value for terrestrial wildlife. Because of the water depth and limited amount of shoreline and shallow, littoral habitat, the reservoir mainly provides resting areas for waterfowl and some shorebirds and available water for a large variety of other species. The Pitt-Taylor Reservoirs, which hold additional storage for Rye Patch Reservoir, provide a greater habitat value for both resident and migratory wildlife. These smaller reservoirs are consistently more shallow than Rye Patch, maintain a greater amount of shallow-water shoreline habitat, and periodically dry out, thereby increasing plant productivity and food production for wildlife, particularly migratory waterfowl and shorebirds. Increased forage production is partly because of the shallow depths and the increased oxygenation from fluctuating water levels. In 1993-1994, the Pitt-Taylor Reservoirs supported approximately 800 pairs of white-faced ibis (Neel 1998).

The portion of the Humboldt River upstream of Lovelock provides some valuable habitat for wildlife resources; however, portions of this area have been compromised by tamarisk invasion. Increasing channelization and irrigation diversions for agricultural activities within the Lovelock Valley have reduced the amount of native wetland habitats for wildlife resources. Although substantial agricultural activities are ongoing in the Lovelock Valley, the river corridor and upland areas continue to provide habitat for both resident and migratory wildlife species. In addition to the riparian habitat along the river, the agricultural fields provide some forage and cover, depending on the season and environmental conditions. Fallow agricultural fields (from November to April) within the Lovelock Valley are often invaded by ground squirrels, which attracts large concentrations of migrating raptors (Neel 1994, 1998). Downstream of Lovelock, great blue heron rookeries containing up to 25 nests have been documented (Neel 1998). Other areas along the river downstream of Lovelock support dense stands of willow; however, the incidence of this plant community is less than that observed upstream of Lovelock.

<u>Humboldt Sink and Carson Sink</u>

The Humboldt Sink is the closed-basin terminus of the Humboldt River. The Humboldt Wildlife Management Area (WMA), covering 36,235 acres, is located in the Humboldt Sink directly north of the Fallon National Wildlife Refuge and approximately 20 miles north of the Stillwater WMA. The Humboldt WMA was established in 1954 as a primary feeding, nesting, and resting area for migratory birds associated with the Pacific Flyway. It is considered one of the most important wildlife habitats in Nevada and is currently managed by the NDOW.

The Humboldt WMA encompasses three wetland units, including Toulon Lake and both the upper and lower portions of Humboldt Lake (see Figure 3.2-20). Birds typically move among all of these sites (Seiler et al. 1993). Species diversity recorded at the Humboldt WMA parallels that documented within the Lahontan Valley, which supports over 200 bird species, most of these species being migratory (Seiler and Tuttle 1997).

The wetlands systems associated with the Humboldt Sink are generally characterized by wet and dry cycles and vary in size and depth on an annual basis. In 1990, the wetland surface area averaged 12,850 acres. The most common vegetation recorded for the Humboldt Sink wetlands include alkali bulrush, cattails, sago pondweed, and muskgrass (Seiler et al. 1993).

The Humboldt Sink is of greater value for wildlife resources than the Carson Sink. The Carson Sink is considered to be of marginal value for waterfowl because of the lack of adequate foraging opportunities and high salinity levels in this basin (Saake 1998). Water flow from the Humboldt Sink south into the Carson Sink only occurs during high-flow years (e.g., operational releases, increased precipitation). During these high-water events, the increased flow into the Humboldt WMA flushes the wetlands systems, removing accumulated salts. Water flushed from the Humboldt Sink moves south into the Carson Sink. The water in this closed basin ultimately evaporates, concentrating the dissolved water constituents (e.g., salts, metals) over time (Seiler et al. 1993). Constituents tied to the soils may be subsequently removed from the area by wind action across the Carson Sink (and dry portions of the Humboldt Sink), dispersing them across a large area located predominantly to the east of the basin areas (Saake 1998). The quantity of constituents removed by wind erosion is not well documented in the sink. However, in other regions, wind removal has been found to account for up to several million tons a year of material (Feshbach and Friendly 1992).

3.4.1.2 Game Species

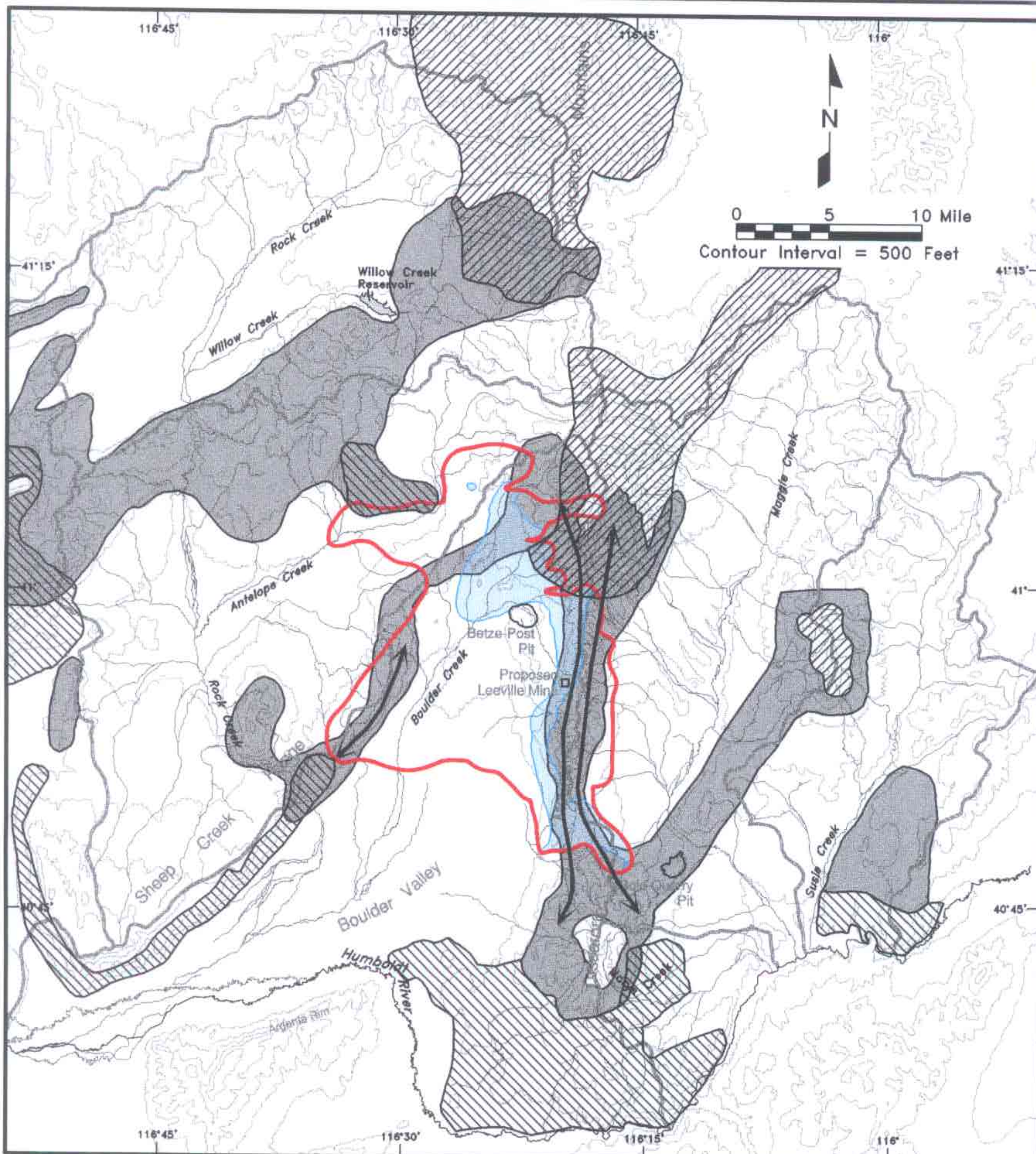
<u>Big Game Species</u>

Mule deer is the most prominent big game species in northern Nevada. The Management Area 6 deer herd that occupies the study area experienced population declines in the past, particularly during the 1992-93 winter season (NDOW 1996a). Mule deer winter and transitional ranges have been affected by wildfires in the project region (Lamp 1999; BLM 2000a). Winter range is considered to be the most limiting factor for the deer population (BLM 1992). However, the herd has been increasing in recent years. This population increase is partly attributed to mild winter seasons and successful rehabilitation of a portion of the winter range, resulting in increased fawn survival rates (Lamp 1999; BLM 2000a).

Seasonal ranges and movement corridors for mule deer that have been documented by NDOW for the area (JBR 1995a; BLM 1992, 1993b, 1996a; NDOW 1998a) are shown in Figure 3.4-1. These areas of use include deer winter range, summer range to the north, intermediate (transitional) range, and the migration or movement corridors between these seasonal ranges (NDOW 1998a). The importance and use of these ranges in any year to the mule deer herd typically depends on such variables as snow depth, forage availability, cover, and weather patterns. The Sheep Creek Range and the Tuscarora Range to the west and east of Boulder Valley, respectively, provide important regional migration corridors for deer. The specific range designations by NDOW and BLM, levels of use, and movement patterns, are described in more detail in JBR (1995a), BLM (1992, 1993b), NDOW (1993a), and the State's annual Herd Composition Survey Narrative, available through NDOW.

Mule deer movements in the transitional habitats of the Tuscarora Mountains along the eastern boundary of Boulder Valley have shifted within the last 11 years. Prior to 1987, deer used both the east and west sides of the range to move south into winter range from summer range located to the north. Since 1987, the majority of deer movement has shifted to the east flank of the mountains along a portion of their route. Although area wildfires have reduced the overall quality of the mule deer habitat along the west side of the Tuscaroras (BLM 1992, 1993b; NDOW 1993a), NDOW primarily attributes the shift in the migratory pattern to mine development along the Carlin Trend (NDOW 1993a).

Transitional range provides valuable habitat for mule deer between their summer and winter ranges. In years with limited or late snow accumulation, the deer remain on the transitional range until snow depths force them into their winter ranges. The longer the deer remain on these transitional ranges, feeding on higher quality forage, the better condition they are in when they move to the lower quality winter range. In addition, the delay in animals arriving on the winter ranges also reduces the amount of pressure on this winter habitat (NDOW 1993a; BLM 1993b, 1996a).



Legend

- Ground Water Basin Boundary
- Stream
- Maximum Extent of 10-foot Drawdown Contour[1]
- Migration Corridors
- Summer Range
- Transitional Range
- Winter Range
- Areas where Perennial Waters could Potentially be Impacted by Drawdown[2]
- Areas where Perennial Waters have a Low Probability of Being Impacted by Drawdown[2]

[1] See text in Section 3.2.2.1 for explanation

[2] Does not include potential impacts to perennial waters located outside the 10-foot drawdown contour.

Figure 3.4-1

Mule Deer Designated Seasonal Ranges

Mountain lion also is a big game species. The relative presence or absence of lions within the study area is generally regulated by distribution of the mule deer population.

Pronghorn occur throughout the study area (JBR 1995a; BLM 1993b), but have only been recorded in any concentrations since the mid-1980s (BLM 1992; JBR 1995a). The northern portion of Boulder Valley is classified as pronghorn winter range, summer, and transitional ranges (Figure 3.4-2) (NDOW 1998a; BLM 1993b). The recently developed agricultural fields (i.e., alfalfa) also may be used by pronghorn to a limited extent (JBR 1995a). Increased fawn survival combined with recent mild winters have contributed to an upward trend in the population numbers; however, the limiting factor for resident pronghorn is available winter range (BLM 2000a). The distribution of pronghorn within the study area is dynamic, changing annually, partly because of the effects from wildfires, wildfire rehabilitation, and the increased agricultural uses of Boulder Valley.

California bighorn sheep occur within the region. As depicted in Figure 3.4-3, a small population of bighorn predominantly occupy portions of the Sheep Creek Range to the west of Boulder Valley (NDOW 1998a).

Upland Game Birds

Upland game birds identified in the study area include sage grouse, chukar, gray (Hungarian) partridge, mourning dove, wild turkey, California quail, and ring-necked pheasant (BLM 1993b; JBR 1989, 1990a, b, 1992a; Neel 1994; Teske 1999). Sage grouse are considered a BLM-sensitive species, and are described in Section 3.6. Chukar are typically associated with more rugged slopes, canyons, and drainages in fair proximity to open water. The gray (Hungarian) partridge is considered widespread but not common and is associated with grasslands, shrublands, and agricultural areas. Mourning doves are more commonly found near water sources, generally nesting in shrubs and trees (Terres 1991). The NDOW released about 44 wild turkeys near Beowawe in 1997 and approximately 25 birds on the TS Ranch in 1999 (Teske 1999). The current distribution of these birds is unknown, but it is assumed that some individuals currently occupy suitable habitat (e.g., woodland areas). California quail previously occurred along the Humboldt River, but the past declines in habitats used for cover have resulted in a reduction in distribution and population numbers (Teske 1999).

Waterfowl

Other game species identified for the study area include a number of waterfowl species associated with the Pacific Flyway. Historically, waterfowl numbers were not high in the Little Boulder basin (e.g., larger spring complexes, Willow Creek Reservoir, perennial streams); however, the incidence of use and number of birds have increased during the last decade. This increase was attributed to TS Ranch Reservoir and mounding of ground water resulting in the formation and expansion of Green, Sand Dune, and Knob springs (see Figure 3.2-1). Increased surface water availability and increased emergent and submergent vegetation in Boulder Valley have provided additional foraging, cover, resting, and breeding habitats for bird species, particularly waterfowl and shorebirds.

To record relative levels of avian use in Boulder Valley resulting from the increased water availability, three aerial surveys were conducted in 1995 (ENSR 1995) that focused on TS Ranch Reservoir and the three springs. Bird surveys were conducted during February, April, and August by helicopter and subsequently confirmed by ground visits. These surveys recorded a number of species of waterfowl and shorebirds using these areas. Common waterfowl observed included American coot, green-winged teal, blue-winged teal, mallard, gadwall, ruddy duck, redhead, and eared grebe. Shorebirds are discussed below for nongame species. Bird counts totaled 2,395, 2,422, and 1,815 for February, April, and August, respectively. After 1995, the number and diversity of birds declined as surface water at TS Ranch Reservoir and the springs was reduced (see Sections 3.2.2.1 and 3.3).

In 1999, water discharges into the reservoir resumed; however, during the first quarter of 1999, spring flows were approximately 25 percent of the levels measured in 1995 (Barrick 1999a). It is assumed that the number of waterfowl using

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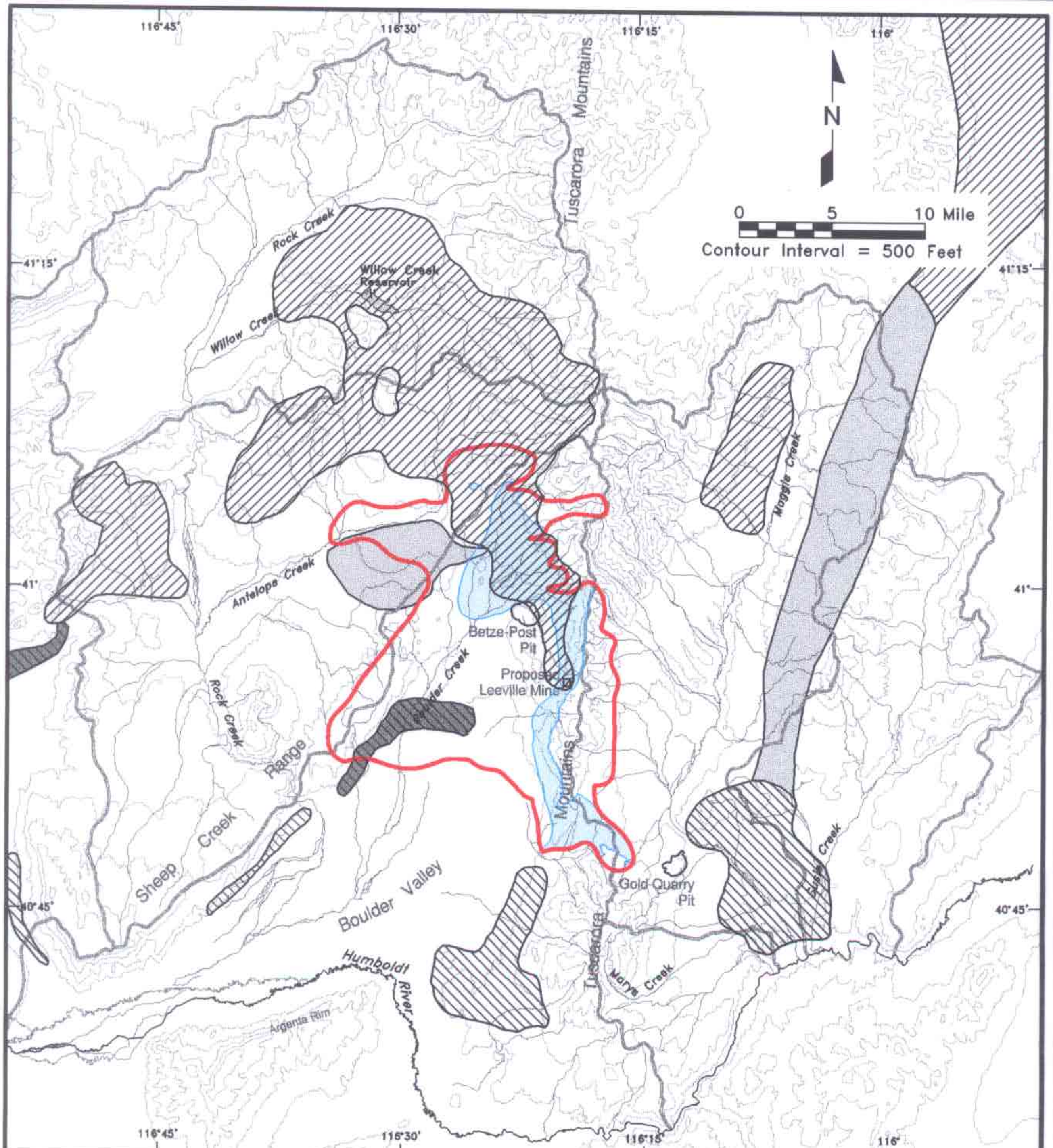


Legend

Ground Water Basin Boundary

Stream

Maximum Extent of 10-foot Drawdown Contour [1]

Summer Range

Transitional Range

Winter Range

Yearlong Range

Areas where Perennial Waters could Potentially be Impacted by Drawdown [2]

Areas where Perennial Waters have a Low Probability of Being Impacted by Drawdown [2]

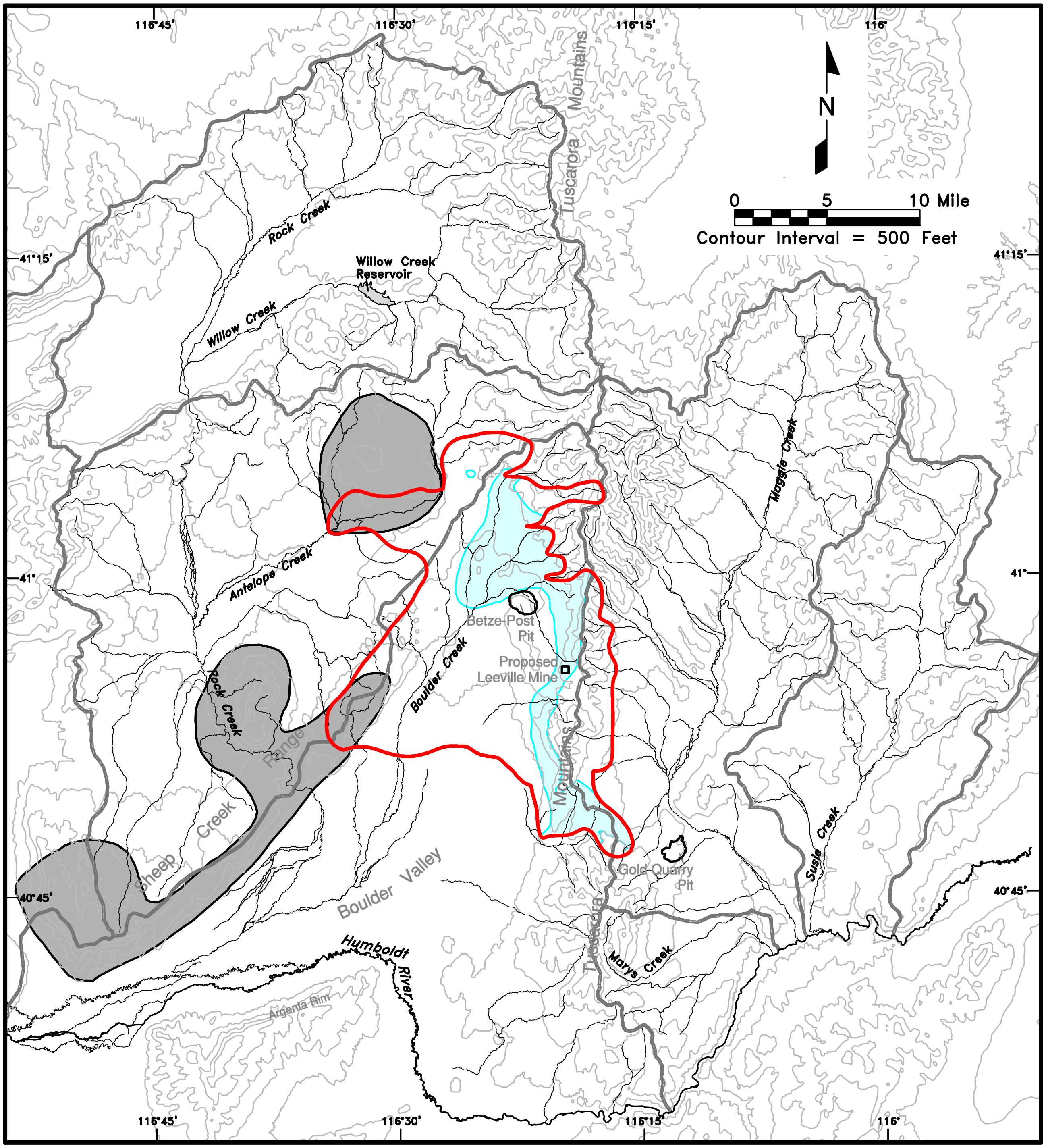
[1] See text in Section 3.2.2.1 for explanation

[2] Does not include potential impacts to perennial waters located outside the 10-foot drawdown contour.

Figure 3.4-2

Pronghorn Designated Seasonal Ranges

\A305\DWG\305BIGH.DWG (layer on: textsels*) REVISION: 7/12/2000 [305bigh.plt]



Legend

Ground Water Basin Boundary

Stream

Maximum Extent of 10-foot Drawdown Contour[1]

Yearlong Range

Areas where Perennial Waters could Potentially be Impacted by Drawdown[2]

Areas where Perennial Waters have a Low Probability of Being Impacted by Drawdown[2]

[1] See text in Section 3.2.2.1 for explanation

[2] Does not include potential impacts to perennial waters located outside the 10-foot drawdown contour.

Figure 3.4-3

California Bighorn Sheep Designated Range these habitats within Boulder Valley fluctuates according to changing water levels. Waterfowl use in the remainder of the study area is restricted to available surface water (e.g., Willow Creek Reservoir, perennial drainages, isolated springs), which is relatively limited.

Waterfowl use along the Humboldt River has been recorded annually by NDOW (Saake 1998), in addition to a number of studies completed by JBR (1992b); Bradley (1992); Bradley and Neel (1990); and Neel (1994). Historically, wetland habitats along the Humboldt River that are located upstream of Battle Mountain provided high quality forage for migrating ducks and important migrational use areas have been documented along the river. One of the four largest canvasback migration corridors in the United States occurs along the Humboldt River (Bradley 1992).

NDOW has collected waterfowl data for the Humboldt River, Humboldt WMA, Stillwater WMA, and Carson Lake over the last 30 years (Saake 1998). Table E-1 in Appendix E summarizes results from the annual duck breeding pair surveys conducted in Region 1 between 1959 and 1998. The average number of breeding pairs of ducks recorded along the Humboldt River ranged between 154 pairs and 365 pairs, with a 30-year average of 266 pairs observed annually along the river corridor. The Humboldt WMA generally supports a greater number of breeding waterfowl than is recorded along the river. From 1959 to 1998, the average number of breeding duck pairs recorded annually for the Humboldt WMA ranged from 161 to 472, with the highest number of duck pairs being 1,049 recorded in 1977. The average annual number of breeding pairs of ducks in the Stillwater WMA and Carson Lake totaled 1,760 pairs and 1,059 pairs, respectively (Saake 1998).

The average annual waterfowl counts for the Humboldt WMA, Stillwater WMA, and Carson Lake are summarized in Table E-2 in Appendix E. The mean number of waterfowl recorded annually between August 15 and January 30 at the Humboldt WMA, Stillwater WMA, and Carson Lake from 1968 to 1997 totaled 2,232,000; 7,723,000; and 4,428,000 individuals, respectively (Saake 1998). Table E-3 in Appendix E summarizes the average number of waterfowl species recorded for the Humboldt WMA between August 15 and January 30 from 1969 to 1998 (Saake 1998). Assuming an even seasonal distribution, the average yearlong numbers also are shown to represent the annual estimate of use of the Humboldt WMA area by waterfowl. This table also depicts the high number of birds recorded for each species during this 30-year period.

The Humboldt WMA provides valuable breeding, foraging, molting, and resting habitats for waterfowl associated with the Pacific Flyway. These data collected over the last three decades (Saake 1998) aid in characterizing the use of these basin systems by waterfowl and shorebird species. In addition to the species listed in Table E-3, American coots, double-crested cormorants, western and/or Clark's grebes, and American white pelicans also have been documented using the Humboldt WMA (USFWS 1999).

In addition to migrants using these wetland areas along the north-south axis of the Flyway, the wetland systems provide a critical staging area for migratory birds as they move from the Great Salt Lake in Utah west to the Sacramento Valley of California. The terminal wetlands provide resources for birds with depleted energy levels, optimizing the foraging and resting opportunities in the Humboldt and Carson Sinks prior to crossing the Sierra Mountain Range located to the west of the basin (Saake 1998).

Seiler et al. (1993) identified possible indicators of habitat degradation at the Humboldt WMA. These indicators included: (1) increased bird mortalities from epizootics that generally affect migratory birds; (2) a decline in native emergent species and an increase in exotic plant species (e.g., tamarisk); (3) a decline in submergent vegetation in upper Humboldt Lake, resulting in less sago pondweed (a good forage plant) and an increase in more salt-tolerant species (e.g., muskgrass); and 4) a reduction in species diversity within the wetlands for both vertebrates and invertebrates.

Furbearers

The beaver, an important species for riparian systems, occurs along the Humboldt River. Historically, beaver have been responsible for channel modifications from their dam building activities (Bradley 1992). Another important furbearer along the Humboldt River is the river otter, which is closely associated with the willow community. A limiting factor for otter along the Humboldt River appears to be den-site availability (Neel 1994). Mink and muskrat have been reported along the river corridor (JBR 1992b). Bobcats also occur sporadically along the Humboldt River. Bobcats have been confirmed near the Comus Gage along the river (Neel 1994), indicating a higher quality habitat that can support both the bobcat and its prey species.

3.4.1.3 Nongame Species

A diversity of nongame wildlife species (e.g., raptors, passerines, small mammals, amphibians, reptiles) is associated with the habitats within the study area. Passerines (songbirds) are numerous and use the entire range of the native habitats (e.g., sagebrush, riparian, grassland, shrubland, wooded uplands) and man-made features (agricultural lands, bridges, abandoned buildings) within the region. The open, arid terrain supports large and varied populations of small mammals that comprise the prey base for the region's mammalian predators and raptor species.

Raptors

Area raptor species include the more common buteos (e.g., red-tailed hawk, ferruginous hawk), accipiters (e.g., sharp-shinned hawk, Cooper's hawk), eagles (e.g., wintering bald eagles, nesting golden eagles), falcons (e.g., prairie falcon, American kestrel), the northern harrier, the turkey vulture, and owl species (e.g., short-eared owl, great-horned owl, long-eared owl) (BLM 1993b, 1996a; Herron et al. 1985; JBR 1992a, 1995b, 1996a). In addition to these raptors, the rough-legged hawk is a winter resident in northern Nevada (Herron et al. 1985), and the peregrine falcon may forage along the riparian corridors (e.g., Humboldt River). This falcon also has been documented near the Humboldt Sink (Seiler et al. 1993; Seiler and Tuttle 1997).

A number of raptors has been reported in and around the study area. Species observed include the golden eagle, red-tailed hawk, ferruginous hawk, prairie falcon, northern harrier, burrowing owl, and short-eared owl. Based on the size and diversity of the study area, the overall raptor use spans a number of vegetative communities, geological features, and variable terrain between the basins and ranges of northern Nevada. Several raptor species are both residents and migrants in the study area and may nest, forage, or winter throughout the diverse communities that occur along the Carlin Trend and the Humboldt River downstream to the Humboldt Sink. General raptor species are addressed in this chapter, relative to their habitat associations and foraging preferences. Raptors that are considered special status species by the BLM are discussed in Section 3.6 of this SEIS.

Although a number of raptor nests have been recorded within the study area, including the Humboldt River system, the location of these nest sites are not delineated in this document, in order to protect the sites and their inhabitants. These nesting records are important, since they document presence, historical distributions, and suitable breeding habitats. However, since raptors often maintain alternative nest sites within their respective breeding territories or they may establish new nests in previously unoccupied habitats, these historical records are used as references only, and it is assumed that breeding pairs may occupy any potentially suitable nesting site within the study area.

Shorebirds

As discussed for waterfowl, shorebird occurrences within the study area are directly correlated with the availability and amount of surface water resources. In 1995, shorebird use was considered high in the Little Boulder basin, when additional surface water was available at the TS Ranch Reservoir, at the springs, and along the irrigation ditch located south of the springs. Common shorebirds recorded during the aerial surveys of Boulder Valley included the black-necked stilt, American avocet, Wilson's phalarope, and killdeer. White-faced ibis also were recorded (ENSR 1995) and are discussed further in Section 3.6, Threatened, Endangered, Candidate, and Sensitive Species. Subsequent to the surveys, water levels in TS Ranch Reservoir were reduced. This reduction in surface water availability and, therefore, the riparian community in Boulder Valley reduced the amount of suitable habitat for resident and migratory shorebird species. The decline in suitable habitat at TS

Ranch Reservoir, at the three Boulder Valley springs (i.e., Knob, Green, and Sand Dune), and along the irrigation canal south of the springs reduced shorebird numbers in the valley, as these wetland areas reverted back into more upland communities. As discussed previously, water levels in the reservoir have increased, and measured spring flows in the first quarter of 1999 were approximately 25 percent of the 1995 levels (Barrick 1999a). It is assumed that future shorebird use would correlate with water availability in this valley, as well in the surrounding study area.

A large number and diversity of shorebirds are associated with the Humboldt River and the Humboldt Sink. Several documents summarize common shorebird species recorded along the river corridor and at the Humboldt WMA (e.g., great blue heron, black-crowned night-heron, killdeer, spotted sandpiper, American avocet, black-necked stilt) (JBR 1992b; Bradley 1992; Bradley and Neel 1990; Neel 1994; USFWS 1999). Unique or uncommon species reported along the river include the long-billed curlew, greater sandhill crane, snowy egret, great egret, Virginia rail, white-faced ibis, and black tern. Additional unique shorebird species identified farther downstream include the American bittern, a secretive heron that is typically associated with bulrush-cattail marshes, and the American white pelican, recorded directly upstream of Rye Patch Reservoir. During the 1988 NDOW surveys, one sighting of an American bittern was made downstream of the Lander-Humboldt County line (Neel 1994). Discussions for the American white pelican, white-faced ibis, and black tern are presented in Section 3.6, Threatened, Endangered, Candidate, and Sensitive Species.

The long-billed curlew is a large shorebird species that has been declining within the Great basin. In Nevada, this shorebird is often associated with grazed meadows and wetland pastures. Along the Humboldt River, this species is often recorded feeding in irrigated hay meadows (Neel 1994). In 1987, curlew nesting was confirmed along the Humboldt River in Lander County, and birds were observed near Battle Mountain during the breeding season (Bradley 1992). In 1988, this bird was observed during the breeding season near the Comus Gage (Neel 1994).

In 1987, greater sandhill cranes were observed along the Humboldt River near Battle Mountain in Lander County during the breeding season (Bradley 1992). Snowy egrets have been recorded along the Humboldt River (Bradley and Neel 1990; Bradley 1992; JBR 1992b; Neel 1994). After near extirpation at the turn of the century, egret populations have recovered. Sightings have been recorded upstream of the Comus Gage (Bradley 1992; Bradley and Neel 1990; JBR 1992b) and near the town of Winnemucca downstream of the Comus Gage (Neel 1994). Great egrets also were recorded by the NDOW in 1988 near Golconda and farther downstream near Winnemucca (Neel 1994). Egret species found along the Humboldt River are often closely associated with the hardstem bulrush community, which has been decreasing along the river corridor (Neel 1994).

In 1988, a juvenile Virginia rail was documented along the Humboldt River near the Herrin Slough. This sighting coincided with the presence of stands of hardstem bulrush along the river. This shorebird species also was documented in 1988 farther downstream near Winnemucca (Neel 1994).

Songbirds

A variety of songbirds occupy a wide range of habitat types in northern Nevada. As discussed above, the riparian-wetland community primarily associated with naturally occurring springs within the study area, the Humboldt River, and the Humboldt Sink supports a greater diversity of species than the surrounding upland communities. The BLM Elko Field Office estimates that approximately 75 percent of the songbirds (185 species) identified for the Field Office area either directly depend on riparian habitats or utilize them to a greater extent than adjacent upland communities. Bradley (1992), Neel (1994), Bradley and Neel (1990), Rawlings and Neel (1989), and JBR (1990b, 1992a, b, g) contain species lists of representative songbirds recorded for the entire study area.

Three uncommon avian species that are closely associated with the habitat types in this system include the yellow-breasted chat, marsh wren, and loggerhead shrike. The chat is considered an indicator species of the relative health and availability of riparian habitat types along the Humboldt River and has been identified as one riparian-associated species that would most likely decline with the removal of riparian vegetation (Sedgwick and Knopf 1987). In 1987 and 1988, yellow-breasted chats were documented during NDOW's Humboldt River studies near Battle Mountain in Lander County (Bradley 1992; Bradley and Neel 1990) and near the Herrin Slough and Golconda in Humboldt County (Neel 1994). The marsh wren also is considered an indicator species, but more for the hardstem bulrush and cattail communities, which are becoming more uncommon in Nevada. This wren species was documented by NDOW along the Humboldt River in 1988 near Battle Mountain in Lander County (Bradley and Neel 1990). Loggerhead shrike populations are reported to be in decline in portions of their range. This bird species was reported by the NDOW in 1988 along the Humboldt River west of Battle Mountain in Humboldt County (Neel 1994).

Other important avian species indicative of high quality riparian habitats (e.g., dense willow, rose thickets) and recorded during NDOW's surveys included the yellow warbler, common yellowthroat, black-headed grosbeak, blue grosbeak, lazuli bunting, and house wren (Neel 1994).

Mammals

Numerous nongame mammal species occur throughout the study area, occupying a variety of habitat types and elevations. Representative nongame species that inhabit the sagebrush, juniper woodland, grassland, and riparian communities within the study area include the raccoon, badger, porcupine, skunk, coyote, black-tailed jackrabbit, and a variety of rodent and bat species.

An important group of nongame species of concern includes resident and migratory bat species. Bat hibernacula, nursery colonies, and individual roost sites likely occur throughout the study area. Bat surveys were conducted in 1995 and 1996 along selected riparian habitats (e.g., streams, wetlands, stock ponds, riparian corridors) located in Boulder Valley (Ports 1995, 1996). These surveys focused on the potential presence of certain bat species and their use of riparian areas. Surveys also have been conducted east of the Tuscarora Mountains (BLM 1993b, 1996a). Bat species documented during these surveys from trapping activities and echolocation recordings included the small-footed myotis, long-eared myotis, western pipistrelle, big brown bat, and Townsend's big-eared bat. Three bat species documented in the Independence Mountains include the long-legged myotis, long-eared myotis, and small-footed myotis (BLM 1996a). Additional bat species likely to occur within the region include the pallid bat and possibly the silver-haired bat, based on range, distribution, and previous trapping studies (Ports 1995; Ports and Bradley 1996). Additional sensitive bat species are discussed further in Section 3.6, Threatened, Endangered, Candidate, and Sensitive Species.

Amphibians and Reptiles

Amphibians and reptiles in the region are limited because of the cool, dry climate (BLM 1993b). Amphibians are generally associated with aquatic habitats; reptiles occupy drier upland habitats but use the mesic riparian habitats for foraging. The majority of the reptiles and amphibians recorded for the study area are considered to be common (BLM 1993b), except for the Columbian spotted frog, which is discussed further in Section 3.6, Threatened, Endangered, Candidate, and Sensitive Species.

3.4.2 Environmental Consequences

3.4.2.1 Overview

Impacts to terrestrial wildlife from the implementation of Barrick's current and future water management operations depend on the project component, the anticipated process or procedures during mine operation, and relative species' sensitivity. As discussed in the Betze Project Draft EIS, impacts to wildlife could result from decreasing water availability and associated changes in riparian vegetation within the projected drawdown area. The environmental protection measures that were developed for the Betze Record of Decision are summarized in Section 1.6 of this SEIS. These protection measures established for water resources, riparian habitats, and specific wildlife species have been reflected into the following impact assessments.

Since completion of the Betze Project Draft EIS, an open water conveyance canal has been constructed in Boulder Valley as part of Barrick's water management operations. Linear facilities may present long-term barriers to animal movement, potentially restricting genetic exchange within a population. Environmental protection measures identified by JBR (1995a) and implemented by Barrick to minimize impacts from operation of this 14-mile-long project component include: (1) exclusion fencing along the open-water channel to prevent both large and small mammal access; (2) overpass structures or raised ramps at mile intervals to facilitate animal movements and minimize impacts to genetic exchange within a population; (3) escape structures within the open drainage, in the event individual animals gain access to the channel; and (4) a total of 14 gravity-fed water supply developments for area wildlife use, to enhance existing habitats.

The location and orientation of the water canal would not tend to interfere with the designated mule deer seasonal ranges or generalized migration corridors as shown in Figures 1-4 and 3.4-1. Less prevalent and random mule deer movements could be accommodated by the wildlife crossings provided in its design. The pipeline leading to the open canal bisects pronghorn yearlong and winter range (see Figures 1-4 and 3.4-2), but, because the pipeline is buried, no movement interference should occur. The availability of open water sources adjacent to the canal may increase the distribution of pronghorn over time. The canal would not affect bighorn sheep designated range (see Figure 3.4-3).

The canal would restrict some movements and genetic mixing of certain small mammal and reptile species; however, these potential impacts would be considered minor based on the length of this canal in the project region. Birds, including game birds, would not be impacted by canal placement, but the canal would provide an additional water source during project operation.

3.4.2.2 Impacts from Mine Dewatering and Localized Water Management Activities

This section focuses on the potential long-term impacts to terrestrial wildlife species from the drawdown of ground water and the potential for indirect effects to species from reduced surface water availability and a decrease in associated riparian and wetland communities. The potential short- and long-term effects to terrestrial wildlife species from mine water discharges into the Humboldt River and ultimately the Humboldt Sink are addressed in Sections 3.4.2.4 and 3.4.2.5, respectively, of this SEIS.

As discussed in Section 3.2.2.1, a reduction in the ground water levels from mine-induced drawdown could potentially reduce the surface water availability in certain perennial reaches of area streams and naturally occurring springs and seeps, and reduce the associated riparian/ wetland habitats of these sources that are associated with the regional ground water system. It is possible that some springs and other perennial water sources located outside of the 10-foot drawdown contour but within the regional hydrologic study area also could experience changes in flows from ground water drawdown.

Relative to wildlife resources, the following analysis focuses on potential short- and long-term effects to surface water sources, their associated vegetation, and possible use by both resident and migratory wildlife species.

The potential future impacts to surface water resources from Barrick's water management operations are discussed in detail in Section 3.2.2.1. The postmining modeling simulations have identified the extent and timing of drawdown. The general magnitude and extent of drawdown would both directly and indirectly impact wildlife resources. Table 3.2-22 summarizes the springs and seeps that are expected to be affected. These projected future effects would include direct loss of springs and seeps as well as short, isolated perennial stream reaches that are hydraulically connected to the regional ground water system along the western slope of the Tuscarora Mountains. Drawdown from Barrick's water management operations is not expected to affect springs or perennial waters on the eastern slope of the Tuscarora Range. Additional spring sites that are hydraulically connected to the regional ground water also may be impacted, as discussed in Section 3.2.2.1. The maximum extent of these potential effects to surface water availability and the associated riparian communities would occur approximately 100 years after the cessation of mining.

The potential loss or reduction in available surface water could result in long-term changes in wildlife habitats throughout the study area. The habitats associated with naturally occurring springs, seeps, and perennial stream reaches encompass riparian vegetation (both woody and herbaceous plant species), wetland areas (emergents and palustrine), and mesic habitats (moist areas or wet meadows not classified as delineated wetlands that transition into the drier upland communities).

Some impacts or loss of riparian habitats could occur during both the mining and postmining periods. Reduction in subsurface flow could result in effects ranging from decreased plant vigor to the total loss of riparian vegetation cover, depending on a number of hydrological and geological factors (Poff et al. 1997; Scott et al. 1999; Richter et al. 1997). Reduction or loss of riparian habitats associated with these perennial sources would impact terrestrial wildlife dependent on these sources, resulting in a possible reduction or loss of cover, breeding sites, foraging areas, and changes in both plant and animal community structure, as discussed below.

Naturally occurring seeps, springs, and perennial drainages provide important wildlife habitat not otherwise available in the study area. The riparian habitat type and its associated plant communities contribute to a greater wildlife species diversity, compared to the adjacent upland areas. Since surface water and the associated riparian habitat are limiting factors for wildlife in Nevada, the loss of these habitat features would alter the available habitat for species that depend on these riparian areas, resulting in: (1) a reduction of available water for consumption; (2) a reduction in riparian vegetation for breeding, foraging, and cover; (3) reduction in the regional carrying capacity; (4) displacement and loss of animals; (5) a reduction in the overall biological diversity; (6) a potential long-term impact to the population numbers of some species; (7) possible genetic isolation; and (8) reduction in prey availability. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use; species' sensitivity (i.e., level of dependency on riparian areas); and the extent of the anticipated water and riparian habitat reductions.

In the event that perennial flows were reduced, the riparian vegetation would likely decrease, reducing the vegetative structure, composition, and diversity. As surface water decreased, herbaceous riparian obligates would be the first to be affected. Continual ground water reduction would result in increasing stresses on riparian-dependent plants, particularly during the late summer and early fall periods. The reduction in ground water levels beneath these perennial water sources would ultimately affect the maintenance and regeneration of woody shrubs and trees, if the ground water levels were to fall below root systems of these plants that are in contact with ground water levels (Scott et al. 1999; Poff et al. 1997; Richter et al. 1997).

Loss or reduction of perennial water sources and associated riparian habitats would reduce the regional carrying capacity for terrestrial wildlife (i.e., the region located within the ground water drawdown area would support a lower diversity and reduced number of riparian-dependent wildlife species). Animals that use perennial water sources would be displaced as the available water and riparian plants declined.

NDOW and the BLM assume that these limited riparian communities are currently at carrying capacity. In other words, the riparian habitat types that typically occur within a desert system support the greatest number of species that is feasible, given the finite resources associated with these communities. Individuals that are displaced may move into adjacent areas, but it is assumed that these adjacent habitat types are already at their full carrying capacity and would not support additional animals. Therefore, these displaced individuals would be lost from the population, concentrating the remaining animals within smaller habitat areas.

Some springs could support genetically isolated populations; therefore, a reduction or loss of springs could result in a loss of genetic diversity and localized populations within the affected area. Possible genetic loss would be limited to less mobile species, such as amphibians.

Species likely impacted by reductions in perennial water sources and associated habitats would include big game, upland game birds, waterfowl, nongame birds (e.g., raptors, passerines), mammals (e.g., bats), reptiles, amphibians, and fish. The extent of these indirect effects from the mine's dewatering activities would depend on the species' use and relative species' sensitivity, as discussed for each group below.

Big Game

Big game species require water during the summer and fall periods (March 16 to November 15), as well as during the winter period, as needed, to satisfy physiological requirements. The reduction or loss of existing water sources could impact big game use and movements. Figure 3.4-1 depicts the possible loss of perennial surface water that could occur within mule deer summer range in the northern portion of the Tuscarora Mountains. However, the greatest impacts to mule deer would be a reduction or loss of available water on important transitional ranges along the Tuscarora Mountains and the upper Boulder Creek area. The loss or reduction of available water in these areas would force deer into adjacent areas that are already impacted by mining operations along the Carlin Trend. It is assumed that some deer would be lost from the population; however, this loss cannot be quantified.

Pronghorn ranges that may be affected by the loss or reduction of perennial water sources would encompass portions of summer range along the upper portions of Antelope Creek. A small portion of pronghorn transitional range also could be impacted in upper Boulder Valley (see Figure 3.4-2). As discussed for mule deer, the effects to available water within pronghorn summer range would incrementally reduce the range's carrying capacity, displacing animals into adjacent ranges that may not support additional herd numbers.

Only a small portion of bighorn sheep yearlong range occurs within the drawdown area; however, this range is not intersected by areas where perennial waters could be affected by ground water drawdown (see Figure 3.4-3). Given the ground water analysis, no impacts to bighorn yearlong range would be expected.

Upland Game Birds

A reduction in the riparian community would ultimately affect the amount of nesting habitat for mourning doves and both potential brooding and foraging habitat for doves, sage grouse, and chukar. A decline in surface water availability would impact the extent of open water and riparian vegetation along perennial streams. This incremental habitat loss would be long term, and it is assumed that the birds that are closely associated with these riparian areas would be displaced. However, since riparian communities are limited within the study area, it cannot be assumed that displaced individuals would successfully relocate into adequate breeding or foraging habitat in adjacent areas. As discussed above, it is likely that these adjacent habitats would be at carrying capacity and these breeding birds could be lost from the population. A reduction in riparian vegetation also could be a limiting factor in brood rearing during the later summer when food sources, such as upland forbs, may decline due to dry conditions. The estimated acreage of riparian or wetland habitat types located within areas that could be affected by a possible reduction in surface water and vegetation associated with spring, seep, or riparian areas is approximately 150 acres. The percentage of these areas that may be used by upland game birds cannot be estimated; in addition, the potential impacts to mesic habitat and the potential loss of individuals cannot be quantified. Potential effects to sage grouse are discussed further in Section 3.6.

Waterfowl and Shorebirds

Short- and long-term effects to waterfowl and shorebird species that may be present within the study area would vary, depending on the vegetative structure and habitat types associated with springs that may support nesting, foraging, or resting birds. As discussed in Sections 3.4.1.2 and 3.4.1.3, waterfowl and shorebird numbers in the water management area were not historically high. The increased incidence of use and number of birds recently recorded in Boulder Valley were based on the increased surface water availability in the vicinity of the TS Ranch Reservoir. These areas of open water resulted in artificially high numbers of waterfowl and shorebirds beginning in the early 1990s. These numbers declined in correlation with the reduced surface and subsurface flows at TS Ranch Reservoir; at the Green, Knob, and Sand Dune spring sites; and along the irrigation canal located south of these springs. The number of waterfowl and shorebird species using these habitats fluctuates according to the changing water levels (see Section 3.4.1.2).

The long-term impacts to waterfowl or shorebird species commonly associated with the water management area would encompass two separate issues. The artificially created wetlands in Boulder Valley have supported a large number and diversity of waterfowl and shorebirds over the last decade. As the mine discharges diminish in the future, the level of free water that has surfaced within the valley, in addition to the associated riparian and wetland vegetation, would be reduced as well. It is anticipated that the number and species of water birds that use these artificial wetland communities would decline, particularly as the drier, more upland habitats began to re-establish in the Valley. However, based on current anecdotal observations of the soils and vegetation in this area, it appears that the saturated soils are increasing the leaching of minerals and salts into the soil surface and subsurface layers, thereby modifying the associated plant communities. This transition to a vegetative community of more salt-tolerant species would result in a changing wildlife community as well.

The other primary issue would be the water birds associated with the larger, natural spring sites in the foothill regions of the study area, the perennial portions of streams that support adequate riparian habitat and pools for foraging and cover that occur within the drawdown area, and any areas that may experience effects to surface water outside the 10-foot drawdown contour. The long-term reduction or loss of available surface water and associated emergent plants in these naturally occurring wetland areas currently used by water birds would result in the displacement or loss of these birds. As discussed for other wildlife species, it is assumed that the riparian communities potentially affected by the mine's dewatering activities are currently at their respective carrying capacities, given their limited availability in the study area. Therefore, loss of surface water and the associated riparian vegetation at historically occupied wetland areas would result in the displacement and/or loss of the individual birds that are dependent on these resources. This loss may affect the breeding potential of certain species.

In summary, isolated birds and breeding pairs may be impacted by the long-term reduction or loss of surface water and riparian or emergent habitat types, possibly affecting the population viability of certain species; however, the extent of this impact cannot be quantified. It is assumed that the ultimate reduction in bird numbers associated with the artificially created wetlands in Boulder Valley to the premining levels (i.e., once mine dewatering has ceased) would not result in population-level impacts. Potential effects to waterfowl and shorebirds from long-term changes along the Humboldt River and into the Humboldt Sink are discussed in Sections 3.4.2.4 and 3.4.2.5, respectively.

Raptors

As discussed in Section 3.4.1.3, a variety of raptor species may breed, migrate, forage, or roost in or near the study area, including along the Humboldt River corridor and in the Humboldt Sink. The impact analysis focused on the potential short- and long-term impacts to habitats utilized by raptors that could be affected by the ground water drawdown. Possible short- and long-term effects to raptors from ongoing and future mine water discharges into the Humboldt River and the Humboldt WMA are discussed in Sections 3.4.2.4 and 3.4.2.5, respectively.

Potential long-term impacts to raptor species could include loss of potential nesting, roosting, and foraging habitat along the perennial drainages and at the seeps and springs identified in Section 3.2.2 within the drawdown area shown in Figure 3.2-21. These losses would result from an incremental reduction in available habitat for both resident and migratory raptor species. In addition, the regional carrying capacity would be reduced by two factors. The most important factor would be the reduction in the prey base. The availability of riparian-dependent prey species for raptors would be reduced within the area potentially affected by drawdown (see Figure 3.2-21), possibly forcing birds to forage more within the upland habitats, which are not as diverse as the riparian communities. This anticipated loss of prey is not quantifiable. The second factor associated with the carrying capacity for raptors would be the incremental loss of available nest and roost sites. Some raptor species (e.g., red-tailed hawk, Swainson's hawk, Cooper's hawk, sharp-shinned hawk, American kestrel) are closely associated with riparian habitats large enough to support trees and increased shrub density. Other species (e.g., golden eagle, prairie falcon, rough-legged hawk) may use these trees for roosting only, but the drawdown area has limited vertical diversity in plant structure. Therefore, these roost sites are important, particularly for hunting activities. Potential impacts to special status raptor species are discussed in Section 3.6.

Songbirds

The potential short- and long-term effects to both resident and migratory songbird species (including neotropical migrants) from ground water drawdown would parallel those discussed for upland game birds and nongame raptor species. Those songbirds that generally depend on open water and riparian habitats for breeding, foraging, or resting during migration would be the most affected. The incremental loss of riparian or emergent habitats would result in bird displacement and possible reduction in local avian population numbers. Breeding birds could be lost from the population, assuming that the regional carrying capacity would not support riparian-dependent birds moving into adjacent habitats. Migrant songbirds also may be displaced. The additional energy required for individuals to find suitable resting or foraging habitat may compromise some birds' survival during migration. The potential for population-level impacts to occur from ground water drawdown would depend on the relative species' sensitivity, rarity, and habitat associations. The Migratory Bird Treat Act protects migratory birds from direct loss of nest sites, individuals, eggs, or young; however, the Act does not protect potential habitat for avian species. Loss of an active nest site, eggs, young, or adult birds from changes in water availability would be in violation of the Act, whereas the potential for long-term loss of potential habitat from ground water drawdown would not.

Amphibians and Reptiles

Potential impacts to amphibian and reptile species that are associated with the perennial water sources that may be affected by Barrick's ground water drawdown activities would parallel those discussed for other terrestrial wildlife species. The loss or reduction in surface water availability and associated riparian vegetation would result in an incremental loss of suitable breeding, foraging, and cover habitats for these species that depend on these areas. Some springs could support genetically isolated populations of certain amphibian species. A reduction or loss of spring sites could, therefore, result in a loss of genetic diversity and localized populations within the projected drawdown area. Population level effects to either amphibian or reptile species could occur in the long term, depending on the extent of the surface effects from ground water drawdown and the relative sensitivity of the species affected.

Summary

As discussed above, the existing environmental protection measures to which Barrick has committed are summarized in Section 1.6 of this SEIS. The implementation of these measures would partially mitigate the anticipated impacts to terrestrial wildlife resources from future effects to perennial water sources and associated riparian habitats in the long term. These measures would aid in offsetting impacts to species from the loss or reduction of available water, riparian or wetland communities, and forage or prey availability. However, the measures would not completely mitigate these anticipated impacts to terrestrial wildlife as discussed in Section 3.4.4.

3.4.2.3 Impacts Associated with the Pit Lake

Aquatic communities could eventually develop in the pit lake(s). Algae would likely develop in the lake and thus act as a food source for primary consumers, such as zooplankton and other pelagic invertebrates. Once the pit lake water level stabilizes, vascular plants and associated benthic macroinvertebrate populations could become established; however, populations should remain relatively low and should not represent a substantial food source for avian or mammalian wildlife.

The distance from the rim of the excavated mine pit to the bottom of the pit would be approximately 1,000 feet following cessation of mining, and the rim-to-lake-surface distance would still be over 100 feet when the lake is full. This distance, combined with the precipitous nature of the pit walls, would substantially restrict access to the lake by terrestrial organisms, although aerial species (e.g., bats and birds) would be able to reach the lake's surface. Therefore, certain wildlife species may be able to use the pit lake as a drinking water source.

To determine if concentrations of metals in the pit lake might pose a risk to birds or mammals consuming the water, median pit lake concentrations were compared to benchmark values from Sample et al. (1996). These benchmark values represent No Observed Adverse Effect Levels (NOAELs) for the ingestion of water. Animals ingesting water with less than or equal to these metal concentrations should not experience adverse effects. The NOAELs were determined experimentally through laboratory studies with test organisms (e.g., rat, mouse, mallard) and then converted (using appropriate equations) for application to wildlife species. For this simple comparison, three species were selected: the rough-winged swallow, red-tailed hawk, and little brown bat. These species may not necessarily be found at the pit lake but are surrogates for organisms that may be found in the pit lake area and may ingest pit lake water (e.g., cliff swallow). All of the benchmark values for these three species exceeded the highest (during any stage of lake filling) median concentration found in the pit lakes (see Table 3.4-1). Based on this comparison, the pit lake water metal concentrations, both in the two early pit lakes and in the final combined pit lake, should not be high enough to cause adverse effects to either mammalian or avian species that consume lake water.

Although median pHs of both the east and west pit lakes are predicted to be slightly alkaline, there is a potential for acidic (pH approximately 5 to 6) conditions up to year 26. Research has found that very acidic (pH less than 4) conditions can cause acute effects to waterfowl (Stubblefield et al. 1997; Foster and Ramsdell 1997). The pH of the pit lakes should be higher than 4.0 and therefore should not pose a significant acute risk to wildlife, although the possibility of chronic effects (e.g., reduced growth and reproduction) may exist. However, no studies have been conducted on the chronic effects of long-term exposure to low-pH water. There should be no risk from low-pH water after 26 years.

3.4.2.4 Impacts to the Humboldt River

As part of the terrestrial wildlife assessment, it is important to note that overall species diversity and habitat characteristics along the Humboldt River have been influenced by past settlement patterns, man-induced channelization projects, and current land uses. These activities historically have altered the overall landscape, vegetative composition, biological character, and wildlife species along the Humboldt River system (see Section 3.4.1.1). The Humboldt River is classified as perennial; however, as with many river systems throughout the arid, western United States, certain reaches are often dry during the late summer and early fall. The extent and distribution of riparian vegetation along the river are determined by seasonal variations, including water scouring during high-flow periods and water availability during low-flow periods (i.e., baseflow).

Increased flows in the Humboldt River from the mine's potential discharges would result in a net increase in available water for terrestrial wildlife, including mule deer, waterfowl, shorebirds, songbirds, raptors, beaver, river otter, and other terrestrial species that are closely associated with these river communities (see Section 3.2.2.2). Increased flows may better support existing plant communities of willow, wild rose, cottonwoods, and emergent vegetation (e.g., bulrush, cattails) immediately adjacent to the river channel, particularly during the low-flow periods (October through February). Increased riparian vegetation would be site-specific, depending on the existing

Table 3.4-1
Highest (from 10 to 233 years) Median Pit Lake Water Concentrations and Benchmark NOAELs[1] for Water Ingestion

Chemical	Highest Concentration (mg/L)	Year/Location	Water Ingestion NOAELs (mg/L)		
			Rough-winged Swallow	Red-tailed Hawk	Little Brown Bat
Aluminum	<0.021	All[2]	471.4	1,930.0	8.188
Antimony	0.066	Yr 26; east lake			1.105
Boron	0.009	Yr 233; combined pit lake	124	507	457
Cadmium	<0.0024	All	6.23	25.51	15.757
Copper	<0.003	All	202.0	826.9	248.5
Fluoride	1.72	Yr 233; combined pit lake	33.5	137.2	666.2
Manganese	<0.002	All	4,284	17,541	1,438
Nickel	<0.017	All	332.61	1,361.76	653.42
Selenium	0.006	Yr 10; west pit lake	2.149	8.797	3.267
Strontium	0.185	Yr 26; west pit lake			4,296
Thallium	0.001	All			0.122
Zinc	<0.002	All	62.3	255.1	2,613.7

[1]Benchmark NOAELs are from Sample et al. 1996.
[2]"All" indicates the predicted concentration is the same in all pit lake configurations and years after mine closure.

condition or health of the plant species present, channel geometry and stability, livestock grazing intensity and season of use, and timing of increased flows. Additional water levels along existing river meanders and old oxbows that currently do not receive sufficient water during the high-flow periods (April through June) could help to establish on-channel ponds and support valuable riparian or emergent vegetation. These backwater areas provide important nesting, brooding, foraging, and resting habitat for many terrestrial wildlife species. Conversely, the greater depths and flows could reduce the potential for some isolated pools and natural sloughs to occur in the river during low-flow conditions, limiting the use by breeding or foraging individuals in these areas.

Increased flows also would aid in maintaining wet hay meadows immediately adjacent to the river channel. These meadows provide marsh-like habitat for terrestrial wildlife, which is of greater value than the drier, upland meadows that are dominated by annual grasses. These wet meadows are second highest in avian diversity (as compared to the willow community), particularly when interspersed with either willow or buffaloberry stands.

Increased water availability from mine dewatering discharges may aid in restoring wetland and marsh habitats (e.g., the Herrin Slough). The Herrin Slough is a valuable area for wildlife located within the Humboldt River floodplain upstream of the Comus Gage. Slightly increased water levels in the river would help maintain moisture in the low-gradient network of side channels that provides high quality habitat for a number of important species (e.g., great blue heron, snowy egret, Virginia rail, gadwall, black-headed grosbeak, lazuli bunting). Maintenance of this river segment is particularly important, since it is likely one of the few reaches that is capable of supporting species that require dense cover, such as mountain lions.

No impacts to terrestrial wildlife from increased water levels in Rye Patch Reservoir would be anticipated, based on the limited extent of shallow, littoral habitats that currently exist along the reservoir shoreline. Increased water levels within the Pitt-Taylor Reservoirs may reduce certain areas of shallow-water habitats for waterfowl and shorebird species, as the increased depth would limit plant productivity and food production in those locations. However, as stated in Section 3.3.2.2, it also is assumed that additional areas that are temporarily inundated with increased flows may produce additional foraging habitat, as emergent and aquatic plants become established.

Increased water in the river channel downstream of Rye Patch Reservoir may be valuable for terrestrial wildlife resources, since many of the native riverine habitats that historically occurred along this river reach have been compromised by past agricultural practices, increased channelization, and tamarisk invasion. Although portions of this reach still maintain high quality habitat and increased species diversity, increased river flows could help improve habitat values in degraded areas.

The Humboldt River's channel sinuosity varies greatly from human-induced changes (e.g., channelization) along the river corridor, thereby affecting the overall habitat values, species diversity, biodiversity, and species density. Limited additional flooding immediately adjacent to the Humboldt River could occur during high-water periods (see Section 3.2.2.2). The potential effects to terrestrial wildlife resources from this flooding would include potential loss of site-specific nesting or feeding sites for certain wildlife species (e.g., waterfowl, shorebirds); however the level of these possible impacts would be expected to be low (see Section 3.2.2.2). Increased yearlong flows would remove some channel habitat along the river corridor that currently provides nesting and foraging habitat. However, additional habitat also could be created in other backwater areas.

Maintaining existing willow stands and enhancing conditions to establish additional willow along the river by increased water flow would improve habitat for a wide diversity of wildlife species. Willows provide both vertical and horizontal structure for breeding sites, escape cover, thermal cover, and bank stability and support the greatest wildlife species diversity along the Humboldt River. Willows are a primary successional species that aid in building and maintaining river floodplains, which are considered high quality wildlife habitat, particularly if mid- and understory species (e.g., wild rose, currant, bulrush, rushes, sedges, meadow grasses) can be maintained.

As described in Section 3.2.2.2, increased water levels during the mine dewatering discharges would be most apparent during the fall and winter (October through February), which is typically the river's low-flow period. These increased flows could result in more open water during low-flow months. Some river reaches that typically freeze because of low-water conditions may remain open from the increased flows. This open water could provide additional foraging areas for wildlife species that commonly feed along the river during the winter, such as wintering bald eagles (see Section 3.6). The effects to the river during the peak flows (April through June) would be less apparent. As compared to the natural flows during this period, the increased water in the channel would be a relatively small change.

In summary, higher flows in the Humboldt River system would likely result in improved maintenance and establishment of riparian vegetation, increased areas of open water during the winter, and improved water quality for both aquatic and terrestrial species during the period of the mine's discharges. These potential effects likely would apply more to birds than other wildlife groups, based on the incidence of avian use (52 percent exclusively associated with the riparian habitat type), the fact that water and its associated habitats are the most limiting factor in northern Nevada, and NDOW survey results from the Humboldt River studies (Bradley 1992; Neel 1994; Bradley and Neel 1990).

3.4.2.5 Impacts to the Humboldt Sink

The impact analysis for terrestrial wildlife associated with the Humboldt Sink focused on the effects from increased water quantity and the potential increase in concentrations of inorganic constituents in the sink. This analysis delineates the differences between the concentration and the increased loading of specific constituents of concern. Because the Humboldt Sink is the closed-basin terminus of the Humboldt River, encompasses the Humboldt WMA (one of the most important wildlife areas in Nevada), and is a primary stopover for waterfowl along the Pacific Flyway, the potential for adverse long-term impacts is a primary concern.

Impacts from increased flows and associated water levels in the Humboldt Sink would parallel those discussed for the Humboldt River. Although this dynamic wetland system is characterized by both wet and dry cycles, additional water flowing into the Humboldt Sink and possibly the Carson Sink would provide increased water for wildlife resources.

Appendix E provides a summary of waterfowl use recorded in the Humboldt WMA, Stillwater WMA, and Carson Lake over the last 30 years (Saake 1998). Impacts from increased water availability would include improved nesting, foraging, and resting opportunities for both resident and migratory waterfowl and shorebird species. In turn, the increase in water availability for these species would increase the relative prey availability for area predators.

Some areas of wetland vegetation within the Humboldt Sink may be flooded with higher water levels, resulting in a temporary loss of potential forage plants and cover for birds. However, emergent wetland vegetation would re-establish along the margins of the sink, resulting in a net increase in the amount of wetland vegetation available for wildlife during the discharge period. Following cessation of Barrick's water management operations, conditions at the Humboldt Sink would eventually return to pre-discharge levels.

The USFWS and USGS have conducted studies on the water quality of the Humboldt Sink, as discussed in Section 3.2.1.3. The purpose of these studies was to determine whether the water quality associated with the Humboldt Sink, and specifically the Humboldt WMA, could adversely affect both terrestrial and aquatic wildlife resources, particularly from the irrigation return water flowing into Toulon Lake and Humboldt Lake.

Premining Risks to Wildlife

Because the Humboldt Sink is a terminal wetland with no outflow, concentrations of ions, including trace metals, must naturally increase in some media in the sink unless removed via wind erosion or catastrophic flooding. Materials entering into the sink may be in the dissolved or suspended form. Suspended materials are likely to settle to the sediment, although they may become resuspended during periods of high wind. Dissolved materials also may eventually precipitate out of solution through complexation and ion interactions that often occur in solutions with higher ionic strengths. Some materials may bioaccumulate in local animal and plants that occupy the Humboldt Sink. Because large numbers of wildlife species are attracted to the sink and depend on its food resources, these species also are exposed to elements and compounds that have accumulated at the sink.

To determine the potential risk to wildlife utilizing the Humboldt Sink prior to Barrick's discharges into the Humboldt River, two methods were employed. First, water concentrations and organism tissue concentrations measured in the sink were compared to concentrations that have been found to potentially cause adverse effects to organisms through water and food ingestion in laboratory and field investigations. Second, to determine the potential cumulative effects of ingesting materials through all routes of exposure (water, food, sediment), a dose to selected receptor organisms was calculated for several chemicals of concern.

Evaluations of risk are often difficult because empirical data are often lacking. Fortunately, the USGS and USFWS have collected information on water, sediment, and tissue concentrations of several constituents for several years near and upstream of the Humboldt Sink (Seiler et al. 1993; Seiler and Tuttle 1997). These data were used in the evaluations presented here. Because the purpose of these evaluations was to examine potential effects prior to mining activity, only data collected prior to November 1990 were used. Also, only data collected from Humboldt Lake were used. Much of the water flowing into

Humboldt Lake has passed through an extensive agricultural diversion system upstream of the lake. Water chemistry in Humboldt Lake is, therefore, reflective of the influence of these diversions and more representative of water in the WMA than is water upstream of the diversions.

Screening Against Literature-Based Concentrations

Mean concentrations of several constituents were calculated with Humboldt Lake data collected from 1990, or earlier (Table 3.4-2). The mean values were then compared to concentrations found in the literature from toxicity studies of that particular constituent. Both water-borne and tissue concentrations were evaluated. Water concentrations were screened against those studies where organisms were exposed via water only. Tissue concentrations were screened against studies where the route of exposure to the test organisms was through the diet, that is, food ingestion. This was deemed appropriate since the organisms for which tissue levels were measured in the USGS/USFWS studies (i.e., aquatic insects, aquatic plants, waterfowl, and fish) are food items for higher-level consumers in the wetland. Screening values were No Observed Adverse Effect Levels, or NOAELs, (highest concentrations that had no significant effects) and Lowest Observed Adverse Effect Levels, or LOAELs, (lowest concentrations that did have significant effects). For some of the constituents there were no studies where the chemical was introduced through water, therefore, only dietary screening was used.

All of the mean water concentrations from Humboldt Lake were well below the NOAEL or LOAEL found in the literature (Table 3.4-3). Tissue concentrations of boron, selenium, and mercury exceeded one or more threshold values (Table 3.4-4). These data suggest that, under premining conditions, some metals could have been in high enough concentrations in the Humboldt Sink to cause adverse chronic effects to wildlife utilizing the sink.

Effects through Food, Sediment, and Water Ingestion

Since initial screening of the chemicals of concern in the Humboldt Sink indicated that some wildlife species could be at risk, a further analysis was undertaken to evaluate the effects of ingesting materials from all possible routes of exposure. Four receptor species, mule deer, great blue heron, mallard duck, and bald eagle, were selected for this evaluation. These species represent organisms that may be found in the Humboldt Sink on a long-term or short-term basis. They are not meant to represent all of the species found at the sink; although they do represent a range of life strategies. Mule deer and the bald eagle are the less frequent visitors, passing through the area on occasion rather than being permanent residents.

For each of the receptor species, the possible routes of exposure were identified. Those routes were:

- Mule deer – water ingestion only
- Great blue heron – water ingestion and fish consumption
- Mallard duck – water ingestion and consumption of aquatic macrophytes (24.7 percent of diet), invertebrates (72 percent of diet), and incidental sediment (3.3 percent of diet)
- Bald eagle – water ingestion and consumption of fish (58 percent) and waterfowl (14 percent); remainder of diet is assumed to be mammals

Factors used to estimate ingestion included body weight and food and water ingestion rates. These factors were all derived from the literature or calculated using USEPA equations (USEPA 1993). If necessary, food ingestion rates were adjusted to a dry weight basis, rather than a wet weight basis.

By combining the amount of a chemical that theoretically might be received by a receptor organism via the different sources, a total daily dose is calculated. For this evaluation, two sets of dose calculations were made; one using mean water, sediment, and tissue (premining)

Table 3.4-2
Surface Water, Sediment, and Tissue Concentrations of Constituents of Concern from Humboldt Lake (1987-1990)

Date of Sample	As	B	Cr	Cu	Li	Hg	Mo	Se	Zn
Surface Water Concentration (µg/L)									
10/7/87	210	3900	<10	<10	660	0.2	31	2	10
3/17/88	56	3500	<1	<1	560	<0.1	27	<1	20
8/24/88	90	4300	<1	--	700	<0.1	38	<1	10
3/28/89	98	5400	<1	--	710	<0.1	44	<1	10
3/26/90	78	4500	1	2	--	<0.1	26	<1	<10
7/9/90	59	2700	2	1	--	0.2	24	1	<10
11/26/90	76	3800	<1	2	--	<0.1	19	<1	<10
Mean	**95**	**4014**	**1.4**	**2.1**	**658**	**0.09**	**30**	**0.8**	**9**
Sediment Concentrations (µg/g dry weight)									
11/26/90 (<2 mm)	20	21	17	16	45	0.02	4	1.1	43
11/26/90 (<62 µm)	21	10	19	17	46	0.08	5	1.4	46
Mean	20.5	15.5	18	16.5	45.5	0.05	4.5	1.25	44.5
Invertebrate (Diptera and Hemiptera) Concentrations (µg/g dry weight)									
6/15/90	14	44	4	20	--	0.10	<1	5.0	58
6/15/90	4.7	29	5	16	--	0.15	<2	2.6	73
8/5/86	7.6	<46	20	26	--	<0.44	<0.93	2.5	--
8/5/86	0.87	<27	<1.6	26	--	0.33	1.7	5.1	170
6/15/90	3.0	29	<1	33	--	0.10	1	4.6	163
Mean	**6.0**	**28**	**6.1**	**24**	**--**	**0.18**	**0.93**	**4.0**	**116**
Plant (*Potamogeton*) Concentrations (µg/g dry weight)[1]									
6/15/90	14	620	1	6	--	0.03	3.1	0.5	15
Whole Fish (carp) Concentrations (µg/g dry weight)									
10/29/86	0.81	<27	6.8	2.6	--	0.46	50	3.9	110
10/29/86	0.96	<23	6.3	1.8	--	0.72	<1	1.9	120
10/29/86	1.2	<26	6.4	3.8	--	0.54	<1	2.4	100
Mean	**0.99**	**12.7**	**6.5**	**2.7**	**--**	**0.57**	**17**	**2.7**	**110**
Bird Liver (mallard, American coot, black-necked stilt) Concentrations (µg/g dry weight)									
Mallard									
7/23/88	0.38	¾	0.62	93	--	0.34	<7	7.2	171
7/23/88	0.40	2.7	0.60	175	--	0.49	<7	7.4	205
7/23/88	0.47	3.9	0.63	189	--	0.35	9	9.8	198
7/23/88	<0.30	3.1	<0.50	117	--	0.27	<7	8.8	188
8/9/88	0.36	9	<2	16	--	0.70	3.8	23	164
8/9/88	0.10	10	<2	46	--	0.71	2	13	167
8/9/88	0.20	9	<2	12	--	0.59	3	20	135

Table 3.4.2 (Continued)
Surface Water, Sediment, and Tissue Concentrations of Constituents of Concern from Humboldt Lake (1987-1990)

Date of Sample	As	B	Cr	Cu	Li	Hg	Mo	Se	Zn
American Coot									
8/9/88	0.30	5	<2	13	--	1.5	4	8.7	93
8/9/88	0.52	8	<2	26	--	0.44	4.7	9.1	96
8/9/88	0.20	5	<2	28	--	0.42		11	121
8/9/88	0.20	5	<2	27	--	3.2	4.3	13	137
8/9/88	0.41	4	<2	35	--	0.42	6	11	118
8/9/88	0.20	3	<2	33	--	0.27	4.3	11	111
8/9/88	0.20	4	<2	32	--	0.27	3	8.5	111
8/9/88	0.28	6	<2	18	--	0.31	4.6	8.8	98
8/9/88	0.50	3	<2	13	--	0.42	4	9.8	88
8/9/88	0.30	<2	<2	26	--	0.41	4	12	132
8/9/99	0.38	5	<2	17	--	0.62	5.6	7.8	144
8/9/88	0.36	5	<2	15	--	0.21	3	10	81
8/4/86	0.36	11	<1.3	63	--	0.41	5.5	15	220
8/4/86	0.39	39	<1.2	29	--	0.75	3.4	9.3	170
8/4/86	0.40	73	<1.1	80	--	0.35	4.4	11	240
8/4/86	0.65	47	<1.3	77	--	0.68	3.9	12	220
8/4/86	0.36	51	<1.2	110	--	0.53	4.5	9.0	200
Black-Necked Stilt									
8/4/86	<0.17	24	<1.1	18	--	4.4	2.5	34	110
8/4/86	<0.18	25	1.4	18	--	0.51	2.1	31	98
8/4/86	<0.17	190	1.9	17	--	0.44	2.1	29	81
8/4/86	<0.18	110	1.4	18	--	0.61	2.3	42	120
8/4/86	<0.17	45	2.6	19	--	0.38	1.7	29	82
7/30/87	<0.20	2	<1	22	--	2.5	2	11	100
7/30/87	<0.20	<2	<1	24	--	2.4	2	31	97
7/30/87	<0.20	<2	<1	16	--	1.9	2	48	86
8/12/87	<0.20	<2	<1	23	--	2.1	2	32	88
8/12/87	<0.20	<2	<1	33	--	2.4	3	23	94
Mean	**0.27**	**21.1**	**0.90**	**44**		**0.95**	**3.62**	**16.95**	**134.24**

Source: Seiler et al. 1993.
[1]Only one premining *Potamogeton* sample was collected from Humboldt Lake.
Note: One-half the detection limit was used to calculated means when the concentration was less than detection.

Table 3.4-3

Mean Surface Water Concentrations Measured in Humboldt Lake and Threshold Effects Levels from the Literature[1]

Constituent	Concentration (mg/L)	Threshold Value (mg/L)	Notes/Source[2]
Arsenic	0.095	5	LOAEL, rat reproduction (Schroeder and Mitchener 1971)
Mercury	0.00009	100	NOAEL, chicken reproduction (Scott et al. 1975)
		5	NOAEL, mouse lifespan (Schroeder and Mitchener 1975)
Molybdenum	0.03	10	LOAEL, mouse reproduction (Schroeder and Mitchener 1971)
Selenium	0.0008	1.5	NOAEL, rat reproduction (Rosenfeld and Beath 1954)
		0.002	Suggested hazardous concentration in water (Lemly 1993)

[1]Water concentrations from Seiler et al. 1993.
[2]LOAEL = Lowest Observed Adverse Effect Level; NOAEL = No Observed Adverse Effect Level.

Table 3.4-4

Mean Tissue Concentrations Measured in Organisms Collected in Humboldt Lake and Threshold Effects Levels from the Literature[1]

Tissue/Organism	Constituent	Concentration (µg/g)	Threshold Value (µg/g)[2]	Notes/Source[3]
Plant (*Potamogeton*)	Arsenic	14	30	LOAEL, growth in female mallards (Camardese et al. 1990)
Plant (*Potamogeton*)	Boron	620	288	NOAEL, mallard reproduction (Smith and Anders 1989)
			10	LOAEL, growth in female mallards (Hoffman et al. 1990)
Fish (carp)	Mercury	0.57	0.5	LOAEL, mallard reproduction (Heinz 1979)
Bird Livers (mallard, American coot, black-necked stilt)	Mercury	0.95		
Fish (carp)	Molybdenum	17	500	LOAEL, chicken reproduction (Lepore and Miller 1965)
			200	LOAEL, growth in chickens (Arthur et al. 1958)
Invertebrate (Diptera & Hemiptera)	Selenium	4.0	5	NOAEL, mallard reproduction (Heinz et al. 1987)
			2.9	LOAEL, avian reproduction (USDI 1998)
Bird Livers (mallard, American coot, black-necked stilt)	Selenium	16.95	3.53	NOAEL, screech owl reproduction (Wiemeyer and Hoffman 1996)

[1]Tissue concentrations from Seiler et al. 1993.
[2]Threshold values are dry weight, or as given in report/article if wet or dry weight was not specified.
[3]LOAEL = Lowest Observed Adverse Effect Level; NOAEL = No Observed Adverse Effect Level.

concentrations and another using maximum (premining) concentrations. The calculated dose of a constituent for each species was compared to the NOAEL that was derived from laboratory toxicity studies found in the literature. Since water and dietary intake were combined in this evaluation, the lowest NOAEL found in the literature was used, regardless of whether exposure in the toxicity studies was through water or diet. In the toxicity studies from which the NOAELs were developed, test organisms were generally the common species used in mammalian or avian studies (e.g., mouse, rat, chicken, mallard). If only a LOAEL was provided for a given study (i.e., the lowest test concentration that caused a significant effect), a NOAEL was calculated by dividing the LOAEL by 10. Because toxicity threshold levels may vary with body size in mammals, mammalian NOAELs were adjusted for each of the receptor species according to body weight (Sample et al. 1996). Avian NOAELs were not adjusted. Laboratory-derived NOAELs (prior to body-weight adjustments) are given in Table 3.4-5. Hazard quotients were calculated by dividing the calculated dose by the NOAEL. Hazard quotients greater than 1 mean that the theoretical dose of a constituent exceeds the dose found, in laboratory toxicity studies, to cause no significant chronic (long-term) effects. Hazard quotients greater than 1 do not necessarily indicate that adverse effects do/will occur, but do indicate that the chemical of concern could pose a risk to wildlife and further investigation could be warranted. When either the mean or maximum concentrations in water, sediment, and tissue are used in this evaluation of premining conditions, none of the hazard quotients exceeded 1.

These evaluations indicate that some constituents in the Humboldt Sink and WMA could have been at high enough concentrations in certain food items to pose some risk of adverse efforts to wildlife that occupy this area on a permanent or temporary basis. Indications of risk are apparent only when comparing measured tissue concentrations to literature-derived threshold values (see Table 3.4-4). Tissue concentrations of boron, mercury, and selenium exceeded one or more of the threshold values. However, no risk was indicated when considering the total dose that a receptor organism might receive. In addition, this evaluation is a simplistic and conservative one, and incorporates many factors that may overestimate the potential for adverse effects. First, the concentration data from Seiler et al. (1993) is limited; only a few samples were collected from the Humboldt Lake area, and those samples were not collected over a wide sample area. Had additional samples been collected over a longer period of time and over a wider area, different trends may have been observed and concentrations might have been higher or lower. It was assumed that 100 percent of water or diet came from the WMA. Because the area is very large, this assumption is likely to be true for the great blue heron and the mallard. However, the mule deer and bald eagle probably obtain food and water from areas outside of the WMA.

In summary, based on the study assumptions, available data from the literature, and likelihood of exposure, risks to avian and mammalian wildlife from metals and other constituents associated with premining conditions could occur, but these risks would be minimal. Because of the dynamic nature of the sink, the substantial influence of upstream water demand, potential naturally and artificially induced fluctuations in water level, and bioaccumulative nature of some metals (such as selenium and mercury), conditions in the sink should not be considered static, in terms of water quality or potential impacts to wildlife receptors.

Potential Risk from Mine Discharge to the Sink

As discussed above, conditions in the Humboldt Sink are such that some risks to wildlife species using the sink could occur, although concentrations measured in water, sediment, and plant and animal tissues indicate the likelihood of impacts is low. Because, under normal conditions, there is no outflow from the sink, the total load of chemicals contained in the sink will increase with time. Unless these chemicals are removed from the sink by events such as flushing (e.g., to the Carson Sink) or wind (during dry periods), they will remain, primarily in the sediments. During mine discharges, additional quantities of some materials would be discharged into the Humboldt River, thus increasing the loads of these materials into the downstream sections of the Humboldt River system, as described in Section 3.2.2.2. An increase in the loading (measured in total quantity, such as tons) of materials would not necessarily result in an increase in risk to organisms using the sink, since it is the concentration (quantity of a material per unit volume or weight, such as milligrams/liter [mg/L] in water, or milligrams/kilogram [mg/kg] in sediments or tissue) of a chemical, and not its load, that controls risk to receptor organisms.

The anticipated increase in the load of selected constituents of concern as a result of mining activities is described in Section 3.2.2.2. Estimated loads to Rye Patch Reservoir and the Humboldt Sink were calculated based on

Table 3.4-5
NOAELS from Laboratory Studies Used to Estimate Risks to Wildlife

Constituent	Test Organism	Dose (mg/kg bw/day)[1]	Source
Arsenic	mouse	0.126[2]	Schroeder and Mitchener 1971
	mallard	5.14	USFWS 1964
Boron	rat	28	Weir and Fisher 1972
	mallard	28.8	Smith and Anders 1989
Chromium	rat	17.61	Steven et al. 1976
	black duck	1	Haseltine et al. 1985
Copper	sheep	0.13[2]	Gopinath et al. 1974
	chicken	27.5	Jackson and Stevenson 1981
Lithium	rat	9.4	Marathe and Thomas 1986
Mercury	mouse	1.25	Schroeder and Mitchener 1975
	Japanese quail	0.45	Hill and Schaffner 1976
Molybdenum	mouse	0.26[2]	Schroeder and Mitchener 1971
	chicken	3.53[2]	Lepore and Miller 1965
Selenium	rat	0.2	Rosenfeld and Beath 1954
	mallard	0.5	Heinz et al. 1987
Zinc	mouse	125	Aughey et al. 1977
	chicken	14.49	Stahl et al. 1990

[1]Dose is based on the body weight (bw) of the test organism.
[2]These NOAELs were calculated by multiplying the LOAELs by an uncertainty factor of 0.1.

historical flows to these areas plus increased loading from the discharge. It is recognized that there are numerous factors that can influence the loading and, more importantly, the concentrations, of chemicals in the Humboldt River and associated lentic (lake) systems. This is especially true of the Humboldt River system downstream of Rye Patch Reservoir where water is diverted for agriculture. As water flows through this diversion system, chemicals in the water may be lost through deposition, and additional chemicals may be collected from the soil and any point and non-point discharges. There is also evaporative loss and consumptive use, which permanently removes water from the system. In addition, periods of high rainfall or drought conditions will affect the volume of materials that enter the Humboldt Sink, as well as their disposition once in the sink.

Estimates of future concentrations of selected constituents entering the Humboldt Sink were made with the understanding that these are general approximations and that certain factors could cause them to increase or decrease. Concentration estimates were calculated by dividing the estimated loads (converted to milligrams) by the total flow volume (in liters) discharged into the Humboldt Sink (Table 3.4-6). The predicted concentrations for arsenic, boron, copper, and zinc were compared to the mean, 1987-1990 surface water concentrations from Humboldt Lake, taken from Table 3.4-2. Except for zinc, the predicted concentrations are all less than the mean concentration used in the risk evaluation of the premining conditions. When the predicted zinc concentration (0.0114 mg/L) is used in the risk calculations, the hazard quotient for all receptor species would not change from premining conditions.

This evaluation of concentrations in the Humboldt Sink influent suggests that the additional loads to the Humboldt Sink associated with mining discharges would not pose additional risk to wildlife using the sink. As discussed under Premining Conditions, the concentrations of some constituents could be high enough to pose a chronic risk to organisms that use the Humboldt Sink; however, that risk would probably not be influenced by mine discharges into the Humboldt River. This conclusion is based on the best

Table 3.4-6
Estimated Concentrations of Select Constituents in Water Entering the Humboldt Sink (estimates combine the contribution from mines and baseflow)

Source	TDS (mg/L)	As (mg/L)	B (mg/L)	Cu (mg/L)	F (mg/L)	Zn (mg/L)
Baseflow – No Mine Discharge	2,936	0.0798	1.965	0.0023	1.887	0.0124
Cumulative Mine Discharge	388	0.0284	0.539	0.0034	1.891	0.0096
Combined	2,018	0.0613	1.452	0.0027	1.888	0.0114
Mean pre-1996 Water Concentration In Humboldt Lake	Not Calculated	0.095	4.014	0.0021	Not Calculated	0.009

information available to-date, including hydrogeological models and USGS/USFWS studies. However, the analyses supporting this conclusion have several uncertainties associated with them. For example, even though actual water, sediment, and tissue concentration data were available for the analysis, the samples reported by the USGS (Seiler et al. 1993; Seiler and Tuttle 1997) were collected infrequently and from only a few locations.

One of the most important unknown factors that could influence risks to wildlife in the sink is the effect of weather and associated precipitation. River flows and mine discharges could be affected by annual precipitation, which could increase or decrease water volumes as well as flush materials into the river from the watershed, thus causing significant alterations in chemical concentrations. Under dry, summer conditions, the total volume of the sink may be substantially reduced. As water evaporates, the concentration of solutes within the sink would increase. Although some materials would be lost to the sediments, the salinity (including trace metals) of the remaining water also would increase. At some point, concentrations of some constituents (including sodium, chloride, sulfate, and other common ions, as well as trace metals) may be high enough to be acutely or chronically toxic to wildlife consuming the water. There also may be a tendency for increased bioaccumulation of some ions, thus increasing risk through food ingestion. These events could occur, regardless of the presence of mine discharge. The presence of additional materials in the sink from mine discharges could result in higher concentrations in the event of dry-weather "lake shrinkage." However, there are currently no data available to evaluate this possibility. Lake size and weather conditions also could affect the type and number of receptor organisms in the sink. If conditions become too unfavorable, wildlife may leave the area, thus reducing risk through reduced exposure. Finally, conditions in the Humboldt Sink could affect risk to wildlife if the system were flushed with large volumes of water, or if drying and wind erosion removed sediment-bound materials. These physical changes to the environment also could affect the types and quantity of plants that grow in the sink, as well as the amount of time wildlife species spend in the area.

In summary, given the limited amount of information available, additional mine discharges to the Humboldt River would not likely cause an increase in risk to wildlife in the Humboldt Sink, beyond what exists under premining conditions. However, it is difficult to predict future conditions in the sink, and, therefore, the possibility exists that risks to wildlife could increase. Some unknown factors that could influence wildlife risks include:

- Precipitation – unusually high precipitation could increase water levels and dilute solutes, resulting in decreased concentrations of certain constituents. It also could encourage use of the area, possible increasing exposure for some species.

- Drought – unusually low precipitation could decrease water levels and concentrate solutes, resulting in increased concentrations and increased exposure. However, unusually low water levels could force some species to leave the area, thus reducing exposure.

- Effect of agricultural diversions upstream of the sink.

- Potential artificial or natural flushing of the area, which may remove materials.

- Loss of salts due to wind erosion.

- Water and sediment chemistry - ions could become trapped in sediments upstream of the sink or within the sink itself; they may or may not be remobilized if water chemistry changes.

3.4.3 Monitoring and Mitigation

If further reduction of surface waters were identified during the existing long-term surface water monitoring programs (see Section 3.2.3), Barrick would coordinate with the BLM to develop feasible water augmentation or improvement measures for affected springs or perennial stream reaches. This measure could include either on-site or off-site guzzler placements, small water pipelines, livestock fencing around existing surface water sources, etc. The feasibility of these options would be discussed relative to the habitat value and species affected in the long term.

To provide off-site habitat enhancement for terrestrial wildlife species, Barrick would coordinate with the BLM to implement specific changes in the land use of the Squaw Creek Allotment. The specific components of this measure would be discussed among the BLM, Barrick, and the lessee, and appropriate improvement measures would be implemented on Barrick's property.

3.4.4 Residual Effects

The primary residual effects to terrestrial wildlife would be the potential long-term loss or reduction of surface water availability and riparian, wetland, or mesic habitats for consumption, breeding sites, foraging activities, and cover from ground water drawdown. Other residual effects from impacts to the naturally occurring springs and perennial drainages from the water management operations would include animal displacement, a reduction in the relative carrying capacity of the plant community, and loss of overall habitat value for area species. Residual effects could result from the accumulation of metals in Humboldt WMA sediments and subsequent accumulation of materials in food items; however, flushing and wind erosion also could remove metals, thus keeping concentrations in sediment and biota at, or below, pre-mining concentrations.

3.4.5 Irreversible and Irretrievable Commitment of Resources

No irreversible commitment of resources would be anticipated for resident or migratory wildlife species associated with this project. However, the loss or long-term reduction in available water and riparian or wetland habitats would be considered an irretrievable commitment of resources for wildlife. The associated reduction in habitat carrying capacity; loss of cover, breeding sites, and foraging areas; animal displacement and potential loss from the population; and potential chronic effects from exposure to pit lake water quality would be considered irretrievable impacts that could occur in the long term.

3.5 Aquatic Resources

3.5.1 Affected Environment

The study area for aquatic resources encompasses four major drainages, which include the Boulder Creek subbasin, Maggie Creek subbasin, Rock Creek subbasin, and the Humboldt River. Of these four drainages, only the Boulder Creek subbasin was discussed in the original EIS for the Betze Project (BLM 1991a). The following information describes aquatic resources in each of the four drainages. The types of information used to characterize aquatic resources include habitat, fisheries, and macroinvertebrates. The discussion for the Boulder Creek subbasin focuses on new or updated information available since the Betze Project EIS was prepared.

3.5.1.1 Boulder Creek Subbasin

Habitat surveys were conducted in Rodeo, Brush, and Boulder Creeks in 1987 through 1993 (JBR 1994). Habitat quality was characterized as poor in the lower and middle portions of the streams, where relatively low flows, grazing, and erosion have affected the streams. Perennial sections of the streams such as the upper portion of Boulder Creek were characterized as moderate habitat quality. Qualitative sampling in 1988 and 1990 indicated that Lahontan speckled dace (*Rhinichthys osculus robustus*) was the only fish species present in Rodeo, Brush, and Boulder Creeks (JBR 1990b, 1988). This species is able to tolerate poor habitat conditions indicative of these streams.

Based on studies conducted in Rodeo, Brush, and the lower and middle portions of Boulder Creek from 1987 through 1993, macroinvertebrate communities were comprised of relatively few taxa that were highly tolerant of environmental stress (JBR 1994, 1992a). The number of taxa ranged from 3 to 16, while mean densities varied between approximately 200 and 3,500 individuals/m^2. Dominant taxa usually were chironomid midges, elmid beetles, and ostracods. The headwaters of Boulder Creek contained moderate numbers of macroinvertebrates and some pollution-sensitive taxa. In Brush and Rodeo Creeks, a shift towards pollution-tolerant taxa occurred beginning in 1990. Possible factors causing this shift included increased sediment loads and relatively low flows (JBR 1994). Brush Creek has been dry since 1994 as a result of mine dewatering (see Section 3.2.2.1) (Adrian Brown Consultants 1997).

3.5.1.2 Maggie Creek Subbasin

Diverse habitat conditions are present in the Maggie Creek subbasin. Maggie Creek and the lower reaches of most of the Maggie Creek tributaries were characterized as low-gradient streams with wide channels (BLM 1993b). Implementation of the Maggie Creek Watershed Restoration Program and controlled grazing on lower Susie Creek has stabilized banks and improved riparian vegetation. The lower reaches in Little Jack, Coyote, and Lynn creeks often dry up during the summer months due to low flows, which limits habitat conditions. In contrast, the headwaters of Little Jack, Coyote Creek, and Simon Creeks and the wet-meadow areas along lower Coyote and Little Jack Creeks contain stable, vegetated channels, with higher flows during the summer.

Beaver Creek originates on the east slope of the Tuscarora Mountains from small springs and seeps. The upper portion of the streamflows through deeply incised canyons, whereas the lower portion meanders through sagebrush-covered hills. In 1994, aquatic habitat was limited in the Beaver Creek drainage by channel size and streamflow (Valdez et al. 1994). Few large, quality pools with overhanging vegetation were present. Below approximately 6,500 feet in elevation, low flows reduced available aquatic habitat. A combination of riparian fencing and controlled grazing, initiated in 1993, has resulted in stable, well-vegetated streambanks and formation of quality pools since the 1994 survey was conducted (Evans 1999).

As part of mitigation for the South Operations Area Project, Newmont in conjunction with BLM and Elko Land and Livestock Company, implemented the Maggie Creek Watershed Restoration Project in 1993. The result of this mitigation plan is that aquatic habitat parameters such as riparian zone width, riparian condition class (percent optimum growth), stream width/depth ratio, bank overhang distance, woody vegetation overhang distance, and percent stream width with quality pools have improved significantly in the Maggie Creek subbasin since 1993 (BLM 1997a). Specific streams with improved conditions included mainstem Maggie, Coyote, Little Jack, and Simon creeks.

Electrofishing surveys were conducted in 10 streams within the Maggie Creek subbasin in 1992 (JBR 1992c). Eight of the streams contained fish populations, with speckled dace representing the most common and widespread species. Other species present included redside shiner (*Richardsonius balteatus*), mountain sucker (*Catostomus platyrhynchus*), brook trout (*Salvelinus fontinalis*), and Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) (LCT). Of these species, one is important as a recreational game fish species (brook trout) and one has Federally threatened status (LCT). Brook trout were present in Spring Creek, while Jack Creek, Little Jack Creek, and upper Maggie Creek contained LCT populations. See Appendix F for additional data on fisheries surveys. The upper 5.5 miles of Coyote Creek, which is located upstream of the 1992 study area, also supports a LCT population (BLM 1994b).

In 1997, fish sampling was conducted in seven streams (Lynn, Maggie, Beaver, Little Beaver, Spring, Little Jack, and Coyote Creeks) located within the Maggie Creek subbasin (AATA International 1997). Species collected in the streams included speckled dace, Lahontan redside (*Richardsonius egregius*), Tahoe sucker (*Catostomus tahoensis*), and LCT. Speckled dace was the most abundant species in the middle and lower portions of all streams. LCT were collected in the upper canyon portions of Beaver, Little Jack, and Coyote creeks, where they dominated the fish numbers. One LCT population also was found in a spring-fed reach in lower Jack (Indian) Creek. Additional information regarding the abundance, habitat preferences, and life history of LCT is provided in Section 3.6, Threatened, Endangered, Candidate, and Sensitive Species.

Fish communities in the Beaver Creek drainage, which flows into Maggie Creek, consist of four species: LCT, speckled dace, Lahontan redside, and Tahoe sucker (Valdez et al. 1994). Juvenile LCT were collected in seven of the nine streams; adults were captured in Beaver Creek, Little Beaver Creek, Toro Canyon, and three unnamed tributaries to Toro Canyon (see Appendix F). The lower segments of Beaver and Little Beaver Creeks also were surveyed in May 1997, with Lahontan redside shiner, speckled dace, and LCT collected in low numbers (AATA International 1998a). Two LCT were collected above the road culvert, these fish were assumed to have been washed downstream during high spring flows. Young-of-the-year were observed in Toro Canyon.

Based on studies conducted in November 1991 and April 1992, streams within the Maggie Creek subbasin exhibited differences in macroinvertebrate productivity and composition (BLM 1994b; JBR 1992c). Moderately diverse and productive communities were present in portions of Little Jack, Fish, Coyote, Maggie, James, Susie, West Cottonwood, Marys, Indian, and Mack Creek. In most instances, the productive and diverse communities were limited to the headwater portions of these streams. The macroinvertebrate assemblage in these streams consisted of a mixture of both pollution-tolerant and pollution-sensitive taxa. Mayflies (*Cinygmula, Drunella grandis*, and *Rhithrogena*), caddisflies (*Capnura, Isoperla*, and *Sweltsa*), and stoneflies (*Hydroptila, Lepidostoma,* and *Zapada*) represented the taxa that were considered sensitive to various types of environmental stress. The middle and lower portions of these streams usually were dominated by pollution-tolerant taxa such as chironomid midges, oligochaete worms, blackfly larvae, and mayflies (*Baetis*). Other streams, including Buck Rake Jack, Cherry Spring, Indian, Jack, Lynn, Simon, and Spring creeks, also contained communities dominated by pollution-tolerant taxa.

Macroinvertebrate sampling also was conducted in 1997 at sites within Little Jack, Spring, Coyote, Toro Canyon, and Beaver creeks (AATA International 1998a, 1997). Low to moderate densities were reported in the streams, with mayflies, caddisflies, Diptera, midges, and amphipods usually representing the most abundant taxa. The upper canyon portions of the streams contained taxa that indicated generally good water quality conditions, while the lower stream portions were dominated by pollution-tolerant taxa.

3.5.1.3 Rock Creek Subbasin

Aquatic habitat has been monitored in numerous streams within the Rock Creek subbasin with emphasis on those perennial segments that support LCT populations (AATA International 1998b; NDOW 1996b; BLM 1994b, 1998c). The following information summarizes habitat conditions in Rock Creek and its tributaries.

Upper Rock Creek

The upper 10 miles of Rock Creek exhibited fair to good habitat conditions in 1977 and 1997 (BLM 1998c). Although bank stability and pool width have declined since 1977, bank cover, stream width-to-depth ratio, and substrate composition have continued to be characterized as fair to good ratings (BLM 1998c). The upper reach contains stable banks and a well developed riparian zone.

Willow Creek

Habitat conditions in Willow Creek, both upstream and downstream of Willow Creek Reservoir, were rated as poor in 1977 (BLM 1994b). Lower Willow Creek below the reservoir was characterized by a complete absence of pools, unstable streambanks, high levels of sedimentation, and a lack of a well developed riparian zone. Limiting habitat parameters in the upper portion of Willow Creek included an absence of quality pools, unstable streambanks, and low to moderate sedimentation (NDOW 1996b). Cattle grazing has impacted the upper and lower portions of the stream. Surveys conducted in 1997 indicated improved habitat conditions (AATA International 1998b). Bank cover and width-to-depth ratio have improved since the earlier surveys (BLM 1998c).

Nelson Creek

Habitat conditions in this headwater tributary to Willow Creek were rated as fair in 1977 and poor in 1997. Limiting factors included sedimentation, few quality pools, unstable streambanks, lack of substrate diversity, and minimal bank cover (AATA International 1998b; NDOW 1996b; BLM 1994b). Cattle grazing and beaver activity have impacted the stream.

Lewis Creek

In general, this headwater tributary to Willow Creek exhibits higher quality habitat compared to most of the Rock Creek tributaries (BLM 1994b). Habitat conditions were rated as fair in 1977. In 1996, bank stability, bank cover, and substrate diversity were rated as fair (NDOW 1996b). A lack of quality pools and low pool/riffle ratio were considered major limiting factors. Habitat conditions were improved in 1997, as indicated by an excellent pool/riffle ratio, very good substrate material, low embeddedness, and bank overhang (AATA International 1998b).

Frazer Creek

Habitat conditions in the upper canyon portion of the stream were rated as poor in 1977, with limiting factors consisting of unstable banks, few quality pools, and lack of substrate diversity (BLM 1994b). In 1996 and 1997, the mid-canyon portion of the stream was rated as fair to excellent habitat quality (AATA International 1998b; BLM 1998c; NDOW 1996b). Stable banks, cover, diverse substrates, and a good mixture of pools and riffles contributed to the high quality habitat. The only limiting factor was a lack of quality pools. Habitat conditions were rated as fair in the lower reach, with a less developed riparian zone compared to the upper reach (BLM 1998c).

Toe Jam Creek

Of the 15-mile section with perennial flow, 13 miles were rated as poor habitat in 1977 (BLM 1994b). Factors limiting habitat quality consisted of unstable banks, lack of streamside vegetation, dominance of fine sediment substrates, and lack of pools with depth. The upper 2-mile section of Toe Jam Creek showed an improvement in bank stability, cover, and mixture of substrates. Habitat quality in 1997 indicated improved conditions, with an overall rating of fair to good aquatic habitat (AATA International 1998b; BLM 1998c). Limiting factors still exist, as indicated by substrate embeddedness and reduced bank cover and bank stability ratings (BLM 1998c).

Based on surveys conducted in the Rock Creek subbasin during June 1996 by NDOW, perennial streams contained LCT and native species such as Lahontan speckled dace, Tahoe sucker, mountain sucker, and redside shiner (NDOW 1996b). LCT were collected in Upper Rock Creek, Lewis Creek, Nelson Creek, Toe Jam Creek, and Frazer Creek. A more detailed discussion of LCT distribution in these streams is provided in Section 3.6, Threatened, Endangered, Candidate, and Sensitive Species. Lahontan speckled dace usually was the most abundant species in the streams. Electrofishing surveys also were conducted in three Rock Creek tributaries (Trout, Soldier, and Coyote creeks) during 1993 and 1996 (BLM 1997b, NDOW 1993b). Lahontan speckled dace was the only species present. Speckled dace, redside shiner, and Tahoe sucker were observed in Antelope Creek (McGuire 1995).

Based on surveys conducted in August 1997, macroinvertebrate communities in upper Rock, Toe Jam, Lewis, Nelson, and Frazer creeks exhibited relatively low densities and moderate taxa richness (AATA International 1998b). Total densities ranged from approximately 237 organisms/meter^2 (m^2) in Toe Jam Creek to 978 organisms/m^2 in upper Rock Creek. The total number of taxa ranged from 21 (Toe Jam Creek) to 33 (Frazer Creek). Mayflies and caddisflies were the most abundant groups in all streams. Other common taxa included dipterans (chironomid midges and blackfly larvae), stoneflies, and beetle larvae. The percent composition of mayflies, stoneflies, and caddisflies indicated generally good water conditions.

3.5.1.4 Humboldt River Basin

Habitat conditions were characterized in 1997 (JBR 1997) at 13 locations extending from Carlin to approximately 2 miles downstream of the Rock Creek confluence (Appendix F, Table F-4). Habitat quality varied throughout the 55-mile section of the river, depending upon the extent of cattle grazing, abundance of pools, bank stability, and streamside cover. The upper four sampling locations (Barth to Dunphy) contained a fair to high abundance of pools; poor to excellent streamside cover; low to moderate grazing; and fair to good bank stability. From Dunphy downstream to the Rock Creek confluence, the river exhibited a fair to high abundance of pools; fair to good bank stability; and mostly low streamside cover.

Historical land use practices involving willow control, livestock grazing, and channelization along the Humboldt River have contributed to the generally less than optimal habitat conditions (Rawlings and Neel 1989). Other factors that have resulted in reduced habitat quality in the river include sediment loads, irrigation diversion, irrigation return flows, and relatively high water temperatures (BLM 1996b). Monitoring studies reported that irrigation return flows have contributed to elevated levels of arsenic in fish in Rye Patch Reservoir and downstream areas (Seiler et al. 1993).

The Humboldt River is considered a warm water fishery that consists of species that can tolerate relatively high sediment loads and warm temperatures. Twenty-three species were reported in previous surveys in the river, with sunfish, catfish, and minnow families containing the most species (see Appendix F, Table F-5). Game fish species occurring in the Humboldt River include channel catfish, white catfish, black bullhead, yellow perch, white bass, largemouth bass, smallmouth bass, sunfishes, and crappies. All of these game fish species were intentionally or accidentally introduced. The only native species in the river are suckers, Lahontan redside, redside shiner, Lahontan tui chub, and Lahontan speckled dace.

Electrofishing surveys were conducted in November and December 1995 at nine sampling locations in the Humboldt River that extended approximately 2 miles upstream of Dunphy downstream to the Rock Creek confluence (JBR 1997). Relative abundance information indicated that the minnow species and Lahontan mountain sucker were the most abundant species, while game fish numbers were relatively low. These results are similar to other surveys conducted in the Humboldt River (JBR 1992c).

Game fish inhabiting Rye Patch Reservoir include walleye, channel catfish, largemouth bass, smallmouth bass, spotted bass, white crappie, and yellow perch. In 1968, walleye (a cold water species) was stocked in Rye Patch Reservoir. Although the walleye population thrived during years with high streamflows, population declines occurred during dry years (BLM 1996b). The extended drought in the 1990s caused the walleye fishery to largely disappear. Presently, most of the remaining walleye spawn downstream of Mill City (French 1994, as cited in BLM 1996b). In the 1970s and early 1980s, walleye spawned between Rye Patch Reservoir and Winnemucca in late March and April at temperatures ranging from 50° to 53°F.

Game fish species comprise a minor portion of the overall fish numbers in the Humboldt Sink area (Sevon 1998). Recreational fishing in this area occurs relatively infrequently due to the low numbers of game fish and limited access. White bass and white crappie, which originate from Rye Patch Reservoir, are the most abundant game fish species in the Humboldt Sink. Other game fish species that are likely present include bullheads, channel catfish, white bass hybrids (wipers), walleye, largemouth bass, smallmouth bass, spotted bass, crappies, sunfishes, Sacramento perch, and yellow perch. Nongame species such as Tui chub, Sacramento blackfish, gambusia, and carp dominate the overall fish numbers. Aquatic habitat in the Humboldt Sink consists mainly of marshy areas with submersed and emergent vegetation.

Several monitoring programs are currently being conducted in the Humboldt River to provide information on community structure and environmental contaminants. Aquatic community structure and function are being assessed by the University of Nevada at 10 mainstem sampling sites. In addition, the USFWS and USGS are conducting a monitoring program to assess surface water quality and trace elements in aquatic vegetation, invertebrates, fish, and birds in the middle and lower portions of the Humboldt River (Wiemeyer and Tuttle 1997). Field data were collected in 1998 and 1999 for this program.

Thirteen locations, which extended from the Barth Mine near Carlin (upstream end) to approximately 2 miles downstream of the Rock Creek confluence (downstream end), were sampled for macroinvertebrates in the summer and fall of 1995 and 1996 (JBR 1997). Macroinvertebrate communities were low to moderately productive, with mean densities ranging from less than 100 to approximately 10,600 organisms/m^2. The highest densities occurred during the fall sampling period. The upper portion of the river from Barth to the Lander County levees contained a higher number of taxa (9 to 18), compared to 3 to 9 taxa in the lower section from Argenta Siding to below the Rock Creek confluence. In general, macroinvertebrate communities in the sampled portion of the Humboldt River were dominated by mostly tolerant taxa that have adapted to fluctuating flows and sedimentation. The most abundant taxa included chironomid midges, mayflies (*Tricorythodes minutus* and *Baetis*), and caddisflies (*Cheumatopysche* and *Hydropsyche*). The mayflies, *Cinygmula* and *Rhithrogena*, also were abundant during one or more sampling periods from Shoshone to the Lander County levees. These two taxa are sensitive to poor habitat conditions. Other sensitive taxa such as stoneflies (*Isoperla, Isogenoides*, and *Taenionema uinta*), caddisflies (*Culoptila* and *Glossosoma*), and dipterans (*Hexatoma, Erioptera*, and *Dicranota*) were present in relatively low numbers in the section between Carlin and the Lander County levees. These taxa were usually absent in the lower section of the river from Argenta Siding to below the Rock Creek confluence. Analyses of the Community Tolerance Quotient (CTQ), which rates the invertebrate's tolerance to environmental conditions, provided additional information regarding habitat conditions in the Humboldt River. The average CTQ values indicated fair habitat conditions in the section from between Carlin and the Lander County levees, and poor habitat conditions from Argenta Siding to below the Rock Creek confluence (JBR 1997).

Macroinvertebrate studies also were conducted between Battle Mountain and Winnemucca in 1995, 1996, and 1998 (Queen of the River Fish Company 1998). In 1998, the sampling stations ranged between Mote and the Eden Valley Bridge in Humboldt County. In general, taxonomic composition and densities were similar to upstream stations sampled by JBR (1997). In 1998, mean densities ranged from 886 organisms/m^2 near Mote to 10,488 organisms/m^2 near the Stonehouse Bridge. The most abundant taxa included chironomid midges, *Tricorythodes minutus* (mayflies), and *Hydropsyche* (caddisflies). The total number of taxa ranged from 9 to 15. Biotic indices, such as the Community Tolerance Quotient and Biotic Condition Index, indicated fair habitat conditions at Mote and the Stonehouse Bridge, and poor conditions at the Comus gage and Eden Valley Bridge. However, the 1998 data indicated improved conditions at the two downstream stations in comparison to 1995 and 1996 results.

3.5.2 Environmental Consequences

3.5.2.1 Impacts from Mine Dewatering and Localized Water Management Activities

Based on the results of the hydrologic modeling and geological characteristics of the various ground water and surface water resources, ground water drawdown from the Goldstrike Mine is not expected to affect springs and perennial waters on the eastern slope of the Tuscarora Mountains. Perennial streams in this area include Maggie, Beaver, Little Beaver, Coyote, Jack, Little Jack, Indian, Cottonwood, Lynn, and Simon creeks, which comprise the Maggie Creek subbasin. Springs and perennial reaches in the Rock Creek and Willow Creek area would not be affected. Since no substantial flow changes would occur in these streams, aquatic communities and their habitat would not be affected by Goldstrike Mine dewatering activities.

Both current and future drawdown would affect springs and some perennial reaches located within the Boulder Creek subbasin. Perennial streams in this subbasin include Rodeo, Brush, Bell, and Boulder creeks. Several springs and perennial and intermittent reaches in Brush and Rodeo creeks have been impacted by current dewatering activities. Brush Creek, a tributary to Rodeo Creek, has been dry since 1994. The effects of drawdown from current dewatering would be a loss of aquatic habitat, native fish (speckled dace), and macroinvertebrate communities. Future drawdown may affect additional springs and perennial reaches in this subbasin, particularly those water bodies located at lower elevations, which generally are not fed by perched springs. If springs and perennial reaches dried up, there would be a loss of aquatic habitat for dace and macroinvertebrates. Water-level reductions in springs and perennial reaches would decrease aquatic habitat and likely result in decreased numbers of dace and macroinvertebrates.

Dewatering activities also could reduce water levels in springs and perennial reaches within the upper Antelope Creek area. Native species such as speckled dace, redside shiner, and Tahoe sucker are present in this stream. Impacts on aquatic habitat and fish and macroinvertebrate communities would be similar to those discussed for the Boulder Creek subbasin.

Based on a review of water quality data, no major water quality trends have been observed to-date within the drawdown area in relation to flow reductions. Exceedences of NDEP water quality standards have been documented in the Boulder Creek subbasin, but it is not possible to determine if these changes resulted from flow reductions. Future exceedences of water quality standards likely would occur in the Boulder Creek subbasin. In general, speckled dace and macroinvertebrate taxa that inhabit these streams are tolerant to fluctuating temperatures, pH, flow, and other water quality parameters. It is anticipated these aquatic communities would not be affected by slight to moderate changes in water quality, regardless of whether they were caused by reduced flows or other factors.

To-date, no detectable changes in surface water quality have been identified in ground water mounding areas in the Boulder Creek subbasin; therefore, aquatic habitat and biota have not been affected by water management activities.

Future water management activities could cause increased sedimentation in the Boulder Creek subbasin streams. As previously mentioned, aquatic biota that inhabit those streams are generally tolerant to fluctuations in water quality conditions. However, if sediment loads covered substrate surfaces on a frequent basis, macroinvertebrate densities and taxa richness could be reduced.

3.5.2.2 Impacts to the Humboldt River

The effects of increased flows in the Humboldt River on aquatic communities and their habitat were analyzed in qualitative terms for both the present operating conditions and projected future conditions. The effects of these two operating scenarios on water quantity, water quality, and sedimentation are discussed in Section 3.2.2.2.

Barrick's maximum discharges to the Humboldt River occurred in 1997 and resulted in increased flows during all months at both the Battle Mountain and Comus gages. The highest relative change in flow occurred in August through November 1997. The effect of the increased flows on aquatic communities was an increase in the amount of available wetted habitat. This effect was most pronounced in the summer and fall months, when the river remained at relatively high levels. Pre-project conditions were characterized by relatively low flows in the summer, when portions of the channel dried up. Overall, an increased amount of habitat would be beneficial to aquatic communities by providing additional wetted area in the channel. The persistence of higher flows in the summer months should particularly benefit some of the introduced game fish species such as channel catfish, brown bullhead, black bullhead, largemouth bass, and smallmouth bass, which require higher river volumes. The native fish species inhabiting the Humboldt River have adapted to extreme fluctuations in flow. It is not known whether the removal of shallow pools that previously existed in the summer and fall months would affect the ecological requirements of some of the fish species. Most of the native fish species (particularly minnows) are able to spawn and develop in this type of habitat. The reduction of shallow, quiet water areas could affect the development of young fish for some of the fish species. After discharges cease, the amount of habitat available to fish would return to pre-discharge conditions.

Increased flows in the river are not expected to affect fish composition. Although depth increases of approximately 0.8 to 1.0 foot may allow wider dispersal in localized areas, these movements are not expected to affect competition between native and introduced species.

Overall, the effects of increased flows on macroinvertebrate communities would be beneficial, since additional wetted area would be available for development. Productivity would increase in the summer and fall months compared to pre-project conditions when portions of the river dried up. Community composition may change in the summer and fall months to reflect species that prefer relatively higher flows and depths. Taxa that inhabited shallow pools during the low flow period such as hemipterans (beetles), aquatic beetles, dragonfly, and damselfly larvae would likely exhibit reduced numbers, as a result of the increased flow depths. Insect orders that prevail in permanent flow conditions, such as mayflies, stoneflies, caddisflies, and chironomid midges, may exhibit increased densities and number of taxa (Williams 1996). After discharges cease, macroinvertebrate productivity and composition would return to pre-discharge conditions.

As discussed in the Section 3.2.2.2, Impacts to the Humboldt River, increased flows would not substantially increase channel erosion and sedimentation. One section of the river, particularly from Dunphy to Argenta, naturally exhibits large-scale erosion and sedimentation. Fish and macroinvertebrate have adapted to these conditions. It is anticipated that aquatic biota would be able to tolerate any additional sedimentation increase associated with Barrick's discharge.

Effluent discharges resulting from Barrick's present and future operations would not increase metal concentrations in the Humboldt River. Water quality monitoring of metal concentrations during the initial period of operation (October through December 1997) indicated that values did not exceed the NPDES limits, which are based on standards to protect warm water biota. Acute whole effluent toxicity testing for fathead minnow and *Daphnia* spp. (microcrustacean) provided additional evidence that the effluent was not acutely toxic to these organisms. Therefore, effluent discharges from Barrick's dewatering operation into the Humboldt River would not cause fish and macroinvertebrate mortalities as a result of elevated metal concentrations.

Effluent discharges resulting from present and future operations would cause a slight change in river temperatures (< 2°C) compared to pre-project conditions. This relatively small change would meet the State of Nevada standard for protecting warm water biota. Temperature monitoring of the effluent during the period October through December 1997 showed changes ranging from -1°C to +2°C. Temperature changes during future discharges would be expected to be within a similar range. Prior to Barrick's effluent discharge, the shallow braided channels usually existed in the river during the low-flow periods. Present and future discharges would increase water levels in the low-flow period, which may result in a slight increase in river temperatures. However, data are not available to quantify the magnitude of this potential temperature change during the low-flow period.

No flow changes in Humboldt River baseflows are predicted at the end of mining and 100 years postmining. Therefore, aquatic biota and habitat in the Humboldt River would not be impacted during these periods.

3.5.3 Monitoring and Mitigation

Native fish populations are known to occur in potentially impacted areas within the Boulder Creek and upper Antelope Creek drainages. Flows are being monitored in perennial reaches of the Boulder Creek drainage and upper Antelope Creek drainage, which contain habitat for native fish species. Representative reaches will be established in both of these drainages to monitor flows.

If existing surface water monitoring (see Section 3.2.3) indicates flow reductions in the Boulder Creek and upper Antelope Creek drainages BLM resource specialists would determine the need for mitigation. Two options would be used as mitigation: flow augmentation and off-site enhancement. If feasible, flow augmentation would be used for perennial reaches in the Boulder Creek and upper Antelope Creek drainages. Off-site enhancement would consist of improving land use practices in the Squaw Valley Allotment. Fencing would be used to limit grazing in areas near streams such as upper Rock, Toe Jam, and upper Willow creeks. Improvement in riparian vegetation and streambank stability in these streams would enhance habitat for native fish species.

3.5.4 Residual Impacts

There would be residual impacts to native fish species in study area streams. Although off-site enhancement would improve habitat for several streams in the upper Rock Creek drainage, these changes would not replace all affected perennial stream reaches in the Boulder Creek and upper Antelope Creek drainages.

3.5.5 Irreversible and Irretrievable Commitment of Resources

The loss of aquatic habitat (springs and perennial reaches) in the Boulder Creek subbasin and upper Antelope Creek, would be an irretrievable and potentially irreversible impact, if perennial stream reaches dry up. However, off-site enhancement (i.e., improved land use practices in the Squaw Valley Allotment) would mitigate for these irretrievable impacts.

3.6 Threatened, Endangered, Candidate, and Sensitive Species

3.6.1 Affected Environment

Table 3-6.1 summarizes the potential occurrence of special status species including threatened, endangered, candidate, and sensitive species of plants and animals on lands administered by the Elko BLM for this project (as of December 1999), including the area encompassing Barrick's water management operations. This list has been modified since the submittal of the Betze Project Draft EIS.

Nevada BLM policy is to provide Nevada BLM-sensitive and State of Nevada-listed species with the same level of protection as provided for candidate species (BLM Manual 6840.06C). Detailed discussions of sensitive wildlife species identified for Boulder Valley and surrounding areas can be reviewed in a number of sources including: BLM (1991c, 1993b, 1994b, and 1996a); Fox (1993); JBR (1989, 1990b, 1992a, b, d, and 1996a), NNHP (1997); Ports (1995, 1996), and Ports and Bradley (1996). The study area for both the direct and cumulative impact analyses for special status species is comprised of the cumulative assessment area as described in Section 3.2.1, Affected Environment, Water Resources, and Geochemistry.

3.6.1.1 Terrestrial Species

Preble's Shrew

Few site-specific data are available for the Preble's shrew, although it has been reported in the northern portion of the Great Basin. Suitable habitat ranges among sagebrush, grasslands, openings in subalpine forest, and alpine tundra (Fitzgerald et al. 1994; BLM 1993b). This small mammal also is believed to occupy wetland or marshy habitats containing adequate emergent and woody plant species (BLM 1993b, 1996c). The Preble's shrew has been documented in both Washoe County (Hoffmann and Fisher 1978) and in northern Elko County (Ports and George 1990). Currently, it is unknown whether this species occurs in the study area; however, suitable habitat occurs along perennial drainages in the Little Boulder Basin and east of the Tuscarora Mountains (BLM 1996a). The Preble's shrew also may occur along the Humboldt River drainage, since suitable habitat may be present along the river corridor and associated floodplains.

Sensitive Bat Species

Six special status bat species potentially occur within the project region. Of these, four have been positively documented in the study area, including the small-footed myotis, long-eared myotis, long-legged myotis, and Townsend's big-eared bat (see Table 3.6-1) (BLM 1996a, 1993b, 2000a; NNHP 1997; Ports 1995, 1996; JBR 1995b). The myotis species were primarily recorded foraging over riparian and open water habitats; a single Townsend's big-eared bat was observed roosting in an abandoned mine site in Boulder Valley (Ports 1995, 1996). Two male Townsend's big-eared bats were observed in the upper Lynn Creek drainage (BLM 1993b, 1996a, 2000a). Big-eared bats also have been recorded along the North Fork of the Humboldt River and in the northern Tuscarora Mountains (JBR 1995b). Although the current species' distribution of the Townsend's big-eared bat suggests that only the Pacific subspecies occurs in northeastern Nevada, the pale subspecies also has been documented (Bradley 2000). It is unknown which subspecies has been reported for the study area. The remaining two bat species identified as sensitive by the BLM (i.e., spotted bat and fringed myotis) could occur within the study area, based on habitat associations and previous field studies (Ports 1995; Ports and Bradley 1996). Habitat associations for all six of these species range among the upland shrub communities, woodland habitats (e.g., piñon-juniper), riparian areas, rock outcrops, cliff sites, and higher elevational woodland and wetland areas. Detailed information on habitat associations, breeding habits, foraging activities, and roost preferences are available in a number of publications, including: BLM (1996b, 2000a), Ports and Bradley (1996), JBR (1995b), Kunz (1990), Kunz and Martin (1982), Warner and Czaplewski (1984), Manning and Jones (1989), Colorado Division of Wildlife (1984), Arizona Game and Fish Department (1993), Zeveloff (1988), Bats of Nevada (no date), and General History of Nevada Bats (no date).

Table 3.6-1

Special Status Species Identified for the Betze Project Supplemental EIS

Common Name	Scientific Name	Status[1]	Potential to Occur Within Water Management Operations[2]	Potential to Occur Within Proposed Action Area
MAMMALS				
Preble's shrew	*Sorex preblei*	S	U[3]	U
Long-eared myotis	*Myotis evotis*	S	R	N/A
Small-footed myotis	*M. ciliolabrum*	S	R	N/A
Long-legged myotis	*M. volans*	S	R	U
Fringed myotis	*M. thysanodes*	S	U	U
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	S	R	U
Pacific Townsend's big-eared bat	*C. t. townsendii*	S	R	U
Spotted bat	*Euderma maculatum*	N[4]	U	N/A
BIRDS				
Bald eagle	*Haliaeetus leucocephalus*	T[5]	W, M	W, M
Golden eagle	*Aquila chrysaetos*	N	R	R
Northern goshawk	*Accipiter gentilis*	N	R	N/A
Swainson's hawk	*Buteo swainsoni*	N	R, M	R, M
Ferruginous hawk	*B. regalis*	N	R, M	R, M
Osprey	*Pandion haliaetus*	N	M	N/A
Burrowing owl	*Athene cunicularia*	N	R	R
Sage grouse	*Centrocercus urophasianus*	S	R	R
American white pelican	*Pelecanus erythrorhynchos*	N	M	N/A
White-faced ibis	*Plegadis chihi*	N	R, M	N/A
Black tern	*Chlidonias niger*	S	R, M	N/A
PLANTS				
Lewis buckwheat	*Eriogonum lewisii*	S	P	N/A
FISH				
Lahontan cutthroat trout	*Oncorhynchus clarki henshawi*	T	R	N/A
AMPHIBIANS				
Columbia spotted frog	*Rana luteiventris*	C	R	N/A
INVERTEBRATES				
Nevada viceroy	*Limenitus archippus lahontani*	S	R	N/A
California floater	*Anodonta californiensis*	S	R	N/A
Springsnails	*Pyrgulopsis* spp.	None[6]	R	N/A

Sources: BLM 1996a; NNHP 1997; Ports 1995, 1996; Ports and Bradley 1996.

[1]Status:

E: Endangered: Federally listed species in danger of extinction throughout all or a significant portion of its range.

T: Threatened: Federally listed species likely to become endangered within the foreseeable future through all or a significant portion of its range.

C: Candidate: Species identified as warranted for Federal listing, but precluded by other actions to revise the lists.

S: BLM-sensitive species.

N: Nevada-listed species.

[2]Including the Humboldt River corridor.

Table 3.6-1 (Continued)
Special Status Species Identified for the Betze Project Supplemental EIS

[3]Potential Presence:
R = Resident yearlong.
P = Plant populations present.
W = Wintering.
M = Migratory.
U = Unknown whether this species occurs in the vicinity of the project; however, suitable habitat is present.
N/A = Potentially suitable habitat for this species in or near the proposed water pipeline right-of-way is not present or is not considered optimal.

[4]Per wording for Table IIa, in BLM Instruction Memorandum No. NV-98-013 for Nevada State protected animals that meet BLM's 6840 Policy Definition: Species of animals occurring on BLM-managed lands in Nevada that are: (1) protected under authority of Nevada Administrative Codes 501.100 – 503.104; (2) also have been determined to meet BLM's policy definition of "listing by a State in a category implying potential endangerment or extinction;" and (3) are not already included as BLM Special Status Species under federally listed, proposed, or candidate species. Nevada BLM policy is to provide these species with the same level of protection as is provided for candidate species in BLM Manual 6840.06C.

[5]Proposed to be delisted by the USFWS; final decision is pending.

[6]No designation but they are a concern due to their limited distribution.

Hibernacula, nursery colonies, and individual roost sites likely occur within the general region. However, little site-specific information on bat occurrences exists for the study area. Within eastern and northeastern Nevada, the small-footed myotis, long-eared myotis, and long-legged myotis have been reported as being the most common and widespread of resident bat species (Ports and Bradley 1996).

Bald Eagle

The Federally listed bald eagle winters and migrates throughout north-central Nevada (BLM 1994b). Individuals often concentrate in proximity to open water areas during the winter season, where prey species (e.g., fish, waterfowl) may be more abundant, although eagles also utilize carrion and upland birds and mammals. Since 1989, NDOW has conducted winter surveys for birds of prey within the subbasins of Rock Creek, Boulder Creek, and Maggie Creek. Wintering bald eagles have been recorded during one or more of these surveys in all of these subbasins, with two to six eagles using each area (Bradley 1999). Limited open water areas are present during the winter period along Hot Creek and portions of Willow Creek Reservoir (Bradley 1999). No communal roost sites or nests have been reported in the project region (i.e., the Little Boulder Basin, Tuscarora Mountains, Independence Mountains, Sheep Creek Range, Adobe Range, or Humboldt River drainage) (BLM 1993b, 1994b, 1996a; JBR 1995b; Bradley 1999).

Wintering eagle use along the Humboldt River would be considered incidental (Neel 1999). Use would be associated with forage and roost site availability. The bald eagle also has been documented in the vicinity of the Humboldt Sink (Seiler et al. 1993; Seiler and Tuttle 1997; Neel 1999), which provides some foraging opportunities for wintering birds. However, the majority of the Humboldt Sink is frozen during the winter season (Neel 1999), which limits the number of eagles and extent of their use.

Golden Eagle

The golden eagle occurs in nearly all habitat types of the western states, from desert grasslands to above timberline (Johnsgard 1990). In Nevada, the majority of eagles nest on suitable cliffs that overlook sagebrush flats, piñon-juniper forests, salt desert shrub or other habitats that support a suitable prey base (Herron et al. 1985). The golden eagle is a year-round resident within the study area. An active golden eagle nest site was documented along Boulder Creek in 1990 (JBR 1992a). A large number of roosting and foraging eagles also have been reported throughout the region, including along the mountains and drainages associated with the Tuscarora Range (JBR 1992a, f; EIP Associates 1994; Fox 1993). Consequently, it is assumed that golden eagles could nest or forage within the study area (including along the Humboldt River), based on potentially suitable habitat, regional historical records, and these recent sightings.

Northern Goshawk

The northern goshawk is an uncommon forest species that is a year-round resident in northern Nevada, breeding in the higher elevations and wintering in the lower foothills and valleys (Herron et al. 1985). The northern goshawk primarily nests in the higher elevational woodland areas, particularly in aspen and conifer stands (Herron et al. 1985). Potential goshawk habitat within the study area is limited to forest and mountain shrub communities (BLM 1993b), which would be found predominantly in the Tuscarora Mountains, Independence Mountains, Sheep Creek Range, and Adobe Range. Breeding goshawks have been documented in the Independence Mountains (BLM 1993b), and historic NDOW data show the northern goshawk nesting in the northern Tuscarora Range.

Swainson's Hawk

The Swainson's hawk is a summer resident of Nevada. Historically, this species was a common breeder in northern Nevada; however, current records indicate that this neotropical migrant is one of the least abundant raptors in the region. In Nevada, the majority of documented nesting territories occurred in agricultural valleys at elevations ranging from 4,000 to 6,500 feet. Nests have been found in buffaloberry, serviceberry, sagebrush, willow trees, and aspen; however, most of the documented nest sites occur in cottonwood or elm trees in agricultural valleys (Herron et al. 1985). In the study area, one pair of breeding Swainson's hawks was recorded on the Humboldt River floodplain in Lander County in 1987 (Bradley 1992), two Swainson's breeding territories were reported along the river southeast of Boulder Valley in 1992 (JBR 1992b), and territorial behavior was reported along the Humboldt River in the vicinity of Lone Tree Mine's discharge point in 1994 (BLM 1995b). Consequently, additional Swainson's hawk nests could potentially occur within the valleys and riparian zones associated with the study area.

Ferruginous Hawk

This buteo often nests on trees, promontory points, rocky outcrops, cut banks, and infrequently on the ground (Terres 1991; Herron et al. 1985). In Nevada, its preferred breeding habitat is scattered piñon-juniper trees along the interface between the conifer woodland community and the lower desert shrub communities that generally overlook broad valleys used for foraging (Herron et al. 1985). One record of a nesting ferruginous hawk has been documented by the NDOW on the Carlin Trend, and individuals have been recorded in Boulder Valley during spring migration (JBR 1992a). Ferruginous hawks nest in the Tuscarora Mountains (JBR 1996a) and reportedly concentrate in late summer and early fall near the wet meadows associated with the upper reaches of Maggie Creek. This area appears to be a staging area used by the hawks prior to migrating (BLM 1993b). Suitable nesting habitat is limited in the Little Boulder Basin, but individual hawks likely forage within the basin and surrounding areas (JBR 1996a, 1995b). This raptor species also occurs along the Humboldt River drainage. Active nesting along the river would depend on suitable nest substrates, adequate prey base, and minimal human activities in proximity to the nest. In 1994, an active ferruginous hawk nest was recorded in a buffaloberry shrub in the vicinity of a water discharge ditch for the Lone Tree Mine (BLM 1995b), upstream of the Comus Gage.

Osprey

The osprey is primarily a spring and fall migrant in Nevada. Ospreys typically nest in dead snags or in trees within a mile or more from water, but have been known to nest on cliffs, on the ground, and on man-made structures (i.e., power poles, chimneys, windmills, channel buoys, and duck blinds) (Herron et al. 1985). In Nevada, only one nesting pair of osprey was recorded at Lake Tahoe in the 1970s. Since then, failed attempts have been made to attract breeding pairs to Marlette Lake, located 2 miles east of Lake Tahoe, by constructing nesting platforms (Reyser

1985). The diet of this raptor species consists primarily of fish that is usually captured near the water surface, but other sources of food include small mammals, birds, reptiles, and amphibians. Although breeding would be considered unlikely within the study area, migrating osprey may occasionally roost and forage within the region. One osprey was recorded along the Humboldt River in 1988 near the Herrin Slough in Humboldt County. This bird was thought to be a migrant nonbreeder (Neel 1994).

Burrowing Owl

The burrowing owl is a confirmed nesting species in lower Boulder Valley (JBR 1996a) within the study area. In Nevada, burrowing owls have been observed primarily in disturbed sites such as recently burned areas or new troughs, corrals, or mineral licks where livestock concentrates. Nesting habitat for this owl species consists of abandoned mammal burrows on flat, dry, and relatively open terrain. This small owl typically forages in open grassland and sagebrush communities and feeds on insects, small rodents, small birds, reptiles, and amphibians (Terres 1991). Since the burrowing owl generally depends on mammal burrows for nesting, along the Humboldt River it would be restricted to more upland communities.

Sage Grouse

The sage grouse is becoming a focus of western United States land managers and regulatory agencies. A widespread reduction in available sagebrush habitat from wildfire events, livestock management, increased residential and urban development, and resource development activities has resulted in an incremental loss of breeding, nesting, and wintering areas for this species. In addition, the ongoing reduction in riparian and associated mesic communities in the arid portions of the West continues to reduce optimal brooding habitat for this grouse species. The western sage grouse may be petitioned for Federal listing in 2000; however, it is currently unknown when and if this will occur. In the interim, the sage grouse is classified as a BLM-sensitive species and is afforded the same level of protection on BLM lands as Federal candidate species.

Within the study area, sage grouse use the upland sagebrush habitat in rolling hills and benches along drainages for breeding, nesting, and wintering. Mesic and riparian habitats are especially important during brooding and molting periods. Active sage grouse breeding sites, called leks, historically occurred throughout the study area. Since the quality of suitable breeding habitat typically improves with higher elevations, a greater number of grouse leks occur along the foothill regions and in the higher meadows (e.g., upper Rock Creek, northern Tuscaroras, Squaw Valley Ranch) (Lamp 1999). However, previous range fires and subsequent seeding of perennial grasses have reduced the overall habitat value for sage grouse in the Little Boulder Basin west of the Tuscarora Range (JBR 1989). In addition to their wildlife value, sage grouse also are important to the Western Shoshone Culture (see Section 10.2.2).

Available data on historical sage grouse leks within the study area are patchy and scattered. The most comprehensive record of historic lek sites recorded for the study area was obtained from the NDOW's state-wide database (NDOW 1998c) and supplemented with active leks recorded by JBR (1992g) for the study area. An additional sage grouse survey was conducted in April 1995 to determine if historic lek sites located north of the Meikle Mine were active (ENSR 1995). Overall surveys conducted within the Little Boulder Basin infer a general population decline, based on lek counts and reduced use of satellite leks by males in 1989 and 1990 (JBR 1992a). Several of the historic leks were recorded in the 1980s and early 1990s. Because of the recent wildfire events and ongoing mining operations along the Carlin Trend, it is unknown whether the majority of these sites are currently active.

Although a review of the available data indicated a few concentration areas in and near the study area, it is assumed that sage grouse could occur within potentially suitable habitats (i.e., upland, mesic, and riparian) within the entire region, including along the Humboldt River corridor. Exact lek locations are not shown, due to the sensitivity of these breeding sites; however, a summary of the historic lek locations is presented in an effort to characterize past and present use of the entire study area by breeding, nesting, and brooding sage grouse.

A large lek and several small satellite leks have been documented in Little Boulder Basin on the terrace south of Bell Creek (BLM 1994a). Based on historic mapping, approximately 10 to 15 leks have been documented on benches north of the Willow Creek drainage, and 3 historic leks were located north of Antelope Creek (NDOW 1998c). Ten to 15 leks have been recorded in the upper Maggie Creek drainage, in the northern Independence Range, and 5 leks were associated with the southern Independence Range (NDOW 1998c; JBR 1992g). Three leks were documented along the eastern flanks of the Tuscarora Range, 4 leks in the Adobe Range, and up to 7 leks were associated with drainages located west of the Adobe Range, including along Susie Creek and Sixteenmile Creek (NDOW 1998c; JBR 1992g). Few breeding or nesting grouse were recorded along the Humboldt River during the 1988 surveys (Nell 1994); however, it is assumed that they occur in suitable areas.

As stated above, a number of these leks may not be currently active. The lek summary provided for the study area was developed as a basic reference for the impact analysis presented in Section 3.6.2 and the cumulative impact analysis in Section 5.6.

American White Pelican

The American white pelican breeds only at a few locations in the western and north-central United States. In Nevada, white pelicans breed at Pyramid Lake in Washoe County. Nesting habitat consists of inaccessible islands that provide protection from coyotes and other marauding predators, and productive, shallow-water fishing grounds. This species feeds primarily on fish species including the tui chub that occurs in Pyramid Lake and surrounding water bodies. Foraging by the Pyramid Lake colony has been documented 100 miles south of the breeding grounds to Washoe Lake, and as far as 60 miles south and east to Lahontan Reservoir, Humboldt Sink, and the Stillwater marshes (Ryser 1985). During spring migration, white pelicans begin to arrive on their breeding grounds from mid to late March. Post-breeding and migratory movement studies indicate that while adult pelicans generally move northeast and northwest from Pyramid Lake into Utah, Idaho, and Oregon, most of the young pelicans move westward into central California (Ryser 1985). Consequently, based on this species' current distribution and common habitat associations, presence within the study area would be limited to potential migrating and foraging pelicans.

White-Faced Ibis and Black Tern

Wet meadows and both perennial and intermittent wetlands provide habitat for resident and migratory shorebirds, including the white-faced ibis and black tern (Terres 1991). Within the arid habitats of northern Nevada, potential nesting or foraging habitat for these bird species typically fluctuates with available water.

The white-faced ibis has been documented using the Boulder Valley springs, TS Ranch Reservoir, and associated diversion canals within the Little Boulder Basin (ENSR 1995; JBR 1996a). Additional habitats located in the study area for these two water bird species include the wet meadows located along the perennial portions of the drainages occurring in Boulder Valley; along Maggie, Coyote, and Little Jack creeks; and in the Tuscarora Mountains, Independence Mountains, Sheep Creek Range, and Adobe Range (BLM 1993b, 2000a). These species also may use irrigated agricultural lands.

As discussed for general shorebird species in Section 3.4.1.3, shorebird occurrences in the Little Boulder Basin have been closely associated with surface water availability. Shorebird numbers were high during the early 1990s because of the high water levels in the TS Ranch Reservoir, at the associated springs (i.e., Knob, Green, and Sand Dune), and along the irrigation ditch located south of these springs. As the area of surface water diminished during periods when no water was discharged to the reservoir, the amount of suitable habitat within the basin also declined. Therefore, shorebird numbers have fluctuated according to these changing water levels.

Both the ibis and tern have been observed along the Humboldt River (Alcorn 1988; Neel 1994, 1998; Bradley 1992; Bradley and Neel 1990), and terns are occasionally reported in northeastern Nevada, particularly the Ruby Marshes (Alcorn 1988). Historically, white-faced ibis foraged in the sloughs and flooded meadows along the Humboldt River and nested in the emergent vegetation. Currently, the majority of the habitat types that supported nesting ibis have been removed from the Humboldt system (Neel 1994), and ibis populations are declining in the western United States. The majority of white-faced ibis breed within the Great Basin area (Neel 1994). Therefore, the ibis is considered a BLM-sensitive species because of the declining population trends and the reduction in wetland habitats currently occurring within the Great Basin, and specifically Nevada.

In 1986, a nesting colony of 10 white-faced ibis pairs was recorded downstream of Battle Mountain (Bradley and Neel 1990). In 1987, white-faced ibis were documented by the NDOW during the breeding season upstream of Battle Mountain (Bradley 1992), and ibis were reported along the river in 1992 upstream of the mines' discharge points (JBR 1992b). In 1999, a very large nesting colony of white-faced ibis was recorded at the Humboldt Sink. Prominent ibis nesting areas occur at the Herrin Slough (Neel 1994), along the northern portion of Rye Patch Reservoir, at the Humboldt Sink (Humboldt Wildlife Management Area), and south at Carson Lake (Stillwater Wildlife Management Area) (Saake 1998; Neel 1998; Seiler et al. 1993). Typically, white-faced ibis range along the Humboldt River, following the patterns of flood irrigation (Neel 1994).

The black tern is an uncommon nesting species in the Great Basin. Black terns have been recorded along the Humboldt River near Golconda (Neel 1994), downstream of the Comus Gage. This species also could occur in other locations that provide potentially suitable habitat for breeding or foraging.

Nevada Viceroy

This butterfly species is typically associated with willow (*Salix exigua*) habitat, which is used by the larval stage as a host plant (Herlan 1971). Its known distribution is limited to riparian habitat in valley floors below approximately 6,000 feet in elevation. The Nevada viceroy is not abundant in its present distributional range. The use of herbicides and burning of willow species along canals and streambanks have affected the species' distribution (Herlan 1971).

The Nevada viceroy occurs in riparian areas along the Humboldt River and its tributaries (Austin 1998). This butterfly has been reported from Dunphy, Beowawe, and Elko (JBR 1992e) and was observed along the Humboldt River and Maggie Creek in 1990 (BLM 1996a). Approximately 446 acres of potential habitat for the Nevada viceroy was identified and mapped along Little Jack, lower Susie, and Maggie creeks (BLM 1993b). Potentially suitable habitat also occurs along Coyote, Boulder, and Bell creeks; however, no Nevada viceroys have been documented (BLM 1993b, 1996a).

Lewis Buckwheat

Lewis buckwheat is a mounded or matted perennial forb that is restricted to dry, open, relatively barren and undisturbed convex ridge-line knolls and crests underlain by siliceous carbonate and limestone rock types on all aspects (Morefield 1996). Known habitat is characterized by sparse to moderately dense vegetation, typically including low sagebrush (*Artemisia arbuscula*), green rabbitbrush (*Chrysothamnus viscidiflorus*), Indian ricegrass (*Oryzopsis hymenoides*), and squirreltail (*Elymus elymoides*). Lewis buckwheat is endemic to north-central Elko County and northern Eureka County, Nevada; in the Bull Run, Independence, and Tuscarora Mountains; and in the Jarbidge Mountains complex (Morefield 1996). A total of 33 populations, including approximately 665,000 plants, are known to occur in 10 general areas. These populations cover approximately 118 acres on National Forest, private, BLM, and Elko County lands between 6,470 and 9,720 feet in elevation. The majority of these populations have been affected by road-building activities, livestock trampling, fire suppression activities, and mineral exploration. Three of the 33 known populations occur in the central portion of the study area, more specifically, north of Emigrant Pass and adjacent to Marys Mountain at approximately 6,960 to 8,337 feet (Morefield 1996).

3.6.1.2 Aquatic Species

Three aquatic threatened, candidate, and BLM-sensitive species potentially occur within the study area. Of these species, Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) (LCT) is the only Federally listed species (threatened). The

California floater (*Anodonta californiensis*) is a BLM-sensitive species. The Columbia spotted frog (*Rana luteiventris*) is a Federal candidate species. Springsnails currently have no BLM designation; however, they are important because of their limited occurrence and potential for future listing or identification as a candidate or sensitive species. The following discussion summarizes the distribution, abundance, and habitat used by these species or group of species (i.e., springsnails). Habitat characteristics of streams located within the Maggie and Rock Creek subbasins are described in Sections 3.5.1.2 and 3.5.1.3, respectively. Although the Lahontan speckled dace was discussed in the previous EIS, this species is no longer considered a listed or BLM-sensitive species.

Lahontan Cutthroat Trout

The LCT was initially listed as Federally endangered in 1970, but its status was changed to threatened in 1975 to legalize angling and provide for improved management of the species. Historically, LCT occupied streams throughout the Humboldt River drainage. Presently, this species occurs in 83 to 93 streams in the Humboldt River basin, or approximately 318 stream miles (Coffin and Cowan 1995). This constitutes approximately 14 percent of their historic habitat range. Most existing populations are found in eight subbasins that include Marys River, Maggie Creek, Rock Creek, North Fork Humboldt River, East Fork Humboldt River, South Fork Humboldt River, Little Humboldt River, and Reese River.

Maggie Creek Subbasin. The present distribution of LCT within the Maggie Creek subbasin is limited to the following streams: Little Jack Creek, Jack Creek, Coyote Creek, Beaver Creek, Little Beaver Creek, Toro Canyon, Williams Canyon, and mainstem Maggie Creek (Figure 3.6-1). A new population also was documented in Lone Mountain Creek, a tributary to Maggie Creek located in the upper portion of the drainage (Elliott 2000). The estimated miles of occupied habitat in these subbasin streams is listed in Table 3.6-2. The length of occupied habitat may vary annually depending upon streamflows and water temperatures. Of these seven streams, Beaver, Coyote, and Little Jack creeks contain the highest quantity of presently occupied habitat. The present distribution of LCT in the mainstem portion of Maggie Creek is limited to a few scattered locations within an 8-mile segment (Figure 3.6-1). Presently, LCT numbers in Maggie Creek are reduced in comparison to historic numbers. The entire 8-mile

Table 3.6-2
Estimated Miles of Occupied LCT Habitat in the Maggie Creek and Rock Creek Subbasins

Maggie Creek Subbasin	**Occupied**[1]
Maggie Creek Mainstem	8.0
Little Jack Creek	4.6
Coyote Creek	5.2
Beaver Creek	7.1
Little Beaver Creek	1.1
Toro Canyon Creek	2.3
Williams Canyon	1.1
Jack (Indian Creek)	Unknown
Lone Mountain Creek	Unknown
Rock Creek Subbasin	**Occupied**[1]
Frazer Creek	2.6
Toe Jam Creek	4.5
Lewis Creek	3.1
Nelson Creek	4.1
Rock Creek	4.2
Willow Creek Reservoir	2.2

[1]Occupied habitat may vary annually based on streamflow, temperature, and habitat conditions.

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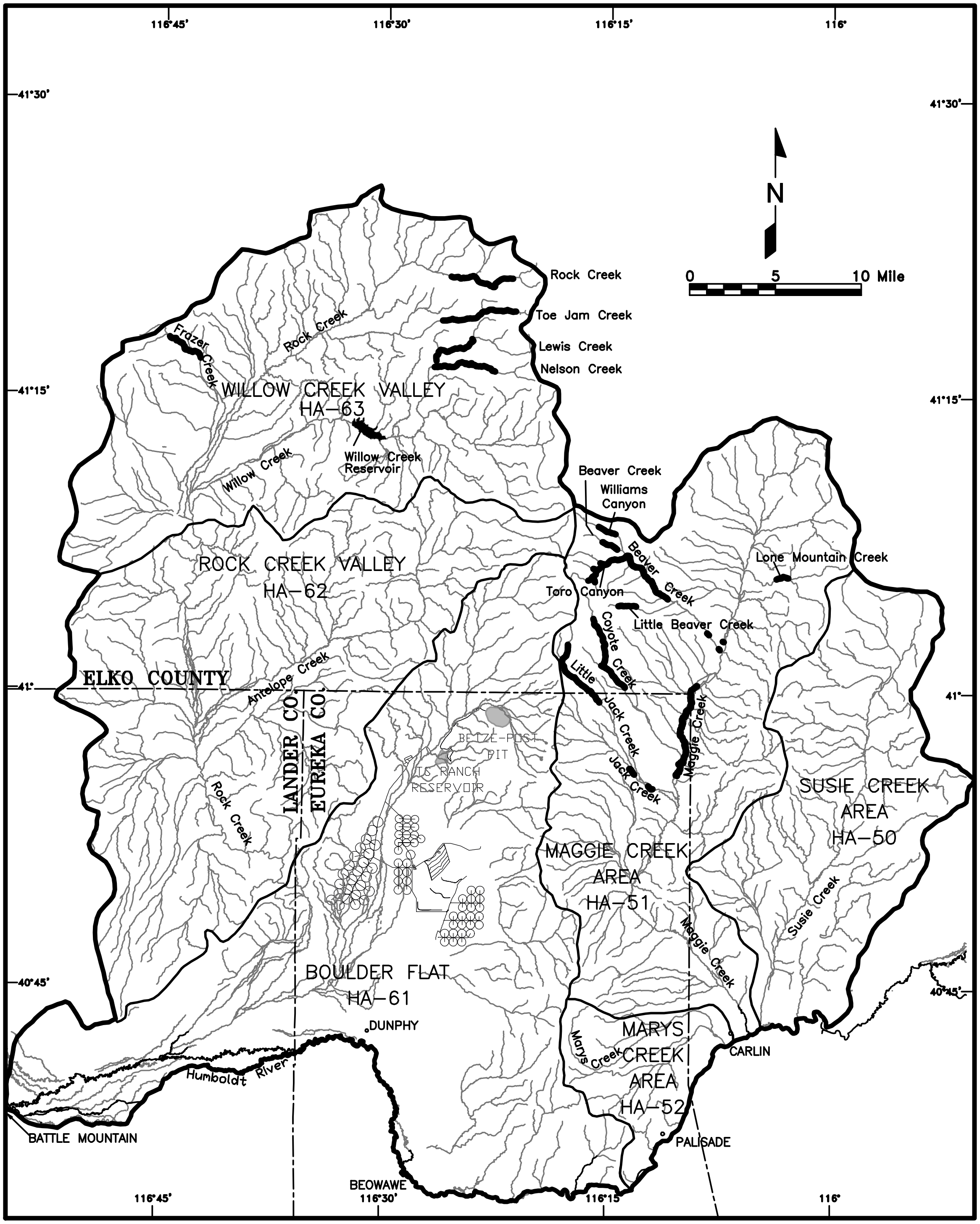


Legend

- Ground Water Basin Boundary
- Stream
- County
- Current Distribution of Lahontan Cutthroat Trout
- Center Pivot Irrigation

Figure 3.6-1

Current Distribution of Lahontan Cutthroat Trout mainstem segment is considered potential habitat because LCT historically occur in Maggie Creek and the Maggie Creek Watershed Restoration Project is improving aquatic habitat. A summary of this restoration project is provided in Section 3.5.1.2, Maggie Creek subbasin.

Previous LCT population surveys in the Maggie Creek subbasin have been conducted by JBR (1992a), BLM (1994b), Valdez et al. (1994), NDOW (1998b, 1996b) and AATA International, Inc. (1998a, 1997). These surveys followed similar electrofishing techniques, except that the survey distance varied in some studies. Overall, LCT densities ranged from approximately 15/mile in Beaver Creek to 2,592/mile in Coyote Creek.

Based on studies conducted by Valdez et al. (1994), LCT were collected in Beaver, Little Beaver, Williams Canyon, and Toro Canyon Creeks, and three tributaries to Toro Canyon (Table 3.6-3). Little Beaver Creek supported the highest densities in this study, with 704 LCT/mile. Recent surveys conducted in 1997 found LCT in Beaver, Little Jack, and Coyote Creeks, with densities ranging from 1 to 52 fish/328 ft sampling segment (AATA International 1997). Total LCT catches and densities/mile for these three streams are shown in Table 3.6-4. Recent sampling also was conducted by NDOW (1999, 1996b) in Little Jack and Coyote creeks, where average LCT densities per mile were 647 and 634, respectively. Three trout (likely LCT) also were observed in Maggie Creek just downstream of the confluence with Coyote Creek in 1997 (NDOW 1998b). The most productive areas for LCT exist in upper Coyote Creek, upper Little Jack Creek, Little Beaver Creek, and Toro Canyon and its tributaries. The mainstem portions of Beaver Creek and Maggie Creek support relatively low LCT densities. The LCT Recovery Plan identified the entire Maggie Creek drainage as a metapopulation. Recovery sites for LCT, expressed in linear miles, include the following streams: Little Jack Creek (1 mile), Maggie Creek (4 miles), Beaver Creek (2.8 miles), Williams Canyon Creek (1 mile) and Coyote Creek (4.8 miles) (Coffin and Cowan 1995). These distances were based on information available as of 1995, and were not intended to limit recovery activities to a specific stream length, or preclude inclusion of additional streams where LCT have been documented. Toro Canyon and Little Beaver creeks also were listed in the LCT Recovery Plan, but linear miles of habitat were not provided.

LCT populations inhabiting the upper canyons of Little Jack, Coyote, Toro Canyon, and Beaver Creeks in 1997 showed evidence of reproduction, since young-of-the-year were abundant (AATA International 1998a, 1997). Below the canyon mouths of these streams, a reproductive population of LCT was found in a spring-fed reach of lower Jack Creek. Limited LCT reproduction has been detected in the mainstem portion of Maggie Creek below beaver dams (JBR 1992e). However, adult LCT in Maggie Creek were observed entering (or attempting to access) tributary streams for possible spawning (Evans 1999; NDOW 1999). LCT that have been found in the lower reaches of the subbasin streams were considered to be “outwash victims” that have been removed from the reproducing populations. Winter habitat conditions are adequate to maintain existing LCT populations, but the number of deeper pools is limited (AATA International 1998c).

Rock Creek Subbasin. An estimated 25 miles of potential LCT habitat exists within the Rock Creek subbasin (BLM 1994b). LCT has been documented in Willow Creek Reservoir and six streams within the Rock Creek subbasin: Frazer, Willow, Toe Jam, Lewis, Nelson, and Rock Creeks (Figure 3.6-1). Previous NDOW surveys in 1959 and 1986 collected LCT in Willow Creek above the reservoir during spawning (Elliott 1999). Based on Aronson (1998), potential seasonal habitat also is present in Rock, Lewis, and Nelson creeks. In terms of linear miles, Toe Jam Creek and Upper Rock Creek contain the highest quantity of occupied habitat. Based on a surveys conducted by NDOW in 1977 and 1996 (as summarized in BLM 1998c), LCT densities ranged from 211 to 581/mile in 1977 and from 70 to 854 in 1996 (Table 3.6-5). Previous surveys conducted between 1955 and 1986 reported densities ranging from 211 to 616 LCT/mile in these streams (BLM 1994b). Recent and historic surveys showed that Frazer Creek is the most productive stream for LCT in the Rock Creek subbasin. NDOW (1996b) reported moderate LCT densities in 1996 (853/mile), while 2,600 LCT/mile were estimated in 1971 (BLM 1994b). Recovery habitat has been identified in

Table 3.6-3
Mean LCT Abundance[1] (number/mile) in the Beaver Creek Drainage, 1994

Stream	Location Number	Life Stage	
		Juvenile	Adult
Beaver Creek	1	0	10
	2	0	0
	3	0	0
	4	44	0
	5	0	0
	6	28	28
	7	15	15
	8	43	43
	9	128	0
	10	15	0
	11	0	0
Williams Canyon	1	0	0
	2	81	0
	3	132	0
Toro Canyon	1	0	0
	2	170	34
	3	270	0
	4	114	0
	5	103	26
Toro Tributary A	1	128	64
Toro Tributary B	1	313	0
Toro Tributary C	1	328	0
Little Beaver Creek	1	0	0
	2	634	70

[1]Number of fish/sampling segment (in feet) was extrapolated to number/mile.
Source: Valdez et al. (1994).

Table 3.6-4
Summary of LCT Densities in Maggie Creek Tributaries, 1997

Stream	Total Catch	No. of 328-foot Segments	Density/Mile
Little Jack Creek	80	13	99
Beaver Creek	2	4	8
Coyote Creek	45	5	145

Source: AATA International, Inc. (1997).

Table 3.6-5
LCT Densities for Rock Creek Subbasin Tributaries

Stream	1977			1996		
	LCT/Mile	No. of Age Classes	Occupied Habitat (miles)	LCT/Mile	No. of Age Classes	Occupied Habitat (miles)
Toe Jam Creek	581	3	4.7	106	2	4.5
Upper Rock Creek	282	4	5.0	70	2	5.0
Upper Willow Creek[1]	211	2	1.0	290[2]	2	1.0
Frazer Creek	320	5	1.0	854	5	2.0

Source: BLM (1998c).
[1]Survey reach extended from above Willow Creek Reservoir to the confluence with Lewis Creek.
[2]The same area was surveyed in 1977 and 1996; however, this portion of Upper Willow Creek was reported by NDOW (1996c) as being part of Lewis Creek.

the following six streams: Frazer Creek (1.5 miles), Lewis Creek (3.8 miles), Nelson Creek (2.6 miles), Upper Rock Creek (10.0 miles), Toe Jam Creek (6.0 miles), and Upper Willow Creek (1.0 mile) (Coffin and Cowan 1995). As previously mentioned, these approximate distances were based on information available as of 1995.

The presence of YOY and yearling-sized LCT in Nelson, Toe Jam, Lewis, and Rock Creeks during 1997 indicated recent reproductive success (AATA International 1998d). Although overwintering habitat exists in the Rock Creek subbasin, it is suboptimal due to the general lack of deep pools typically provided by beaver ponds. Isolated ponds exist, which are often used by LCT.

Ecology and Life History. In general, riverine populations of LCT inhabit small streams with cool water; pools in proximity to cover and velocity breaks; well vegetated and stable stream banks; and relatively silt-free, rocky substrate in riffle-run areas (Coffin and Cowan 1995). Within the Humboldt River basin, LCT can tolerate temperatures exceeding 80°F for short periods of time and daily fluctuations of 25° to 35°F (Coffin 1983; French and Curran 1991). Habitat characteristics of collection sites in Little Jack Creek included pools with overhanging vegetation and gravel substrates (JBR 1992e). Ideal overwintering habitat consists of deep pools (depths $3 feet) with abundant cover such as large woody debris and undercut banks (AATA International 1998d). Beaver ponds, which provide this type of overwintering habitat, are increasing in Maggie, Beaver, Susie, and Rock creeks due to increased availability of willows.

LCT spawning typically occurs from April through July, depending on stream conditions such as flow, water temperature, and elevation. Spawning behavior is similar to other stream-spawning trout, which involves eggs being layed in redds dug in riffle areas over gravel substrates (Coffin and Cowan 1995). Adult maturity is 3 to 4 years for females and 2 to 3 years for males. Generally, spawning occurs every 1 to 2 years rather than consecutive-year spawning. LCT spawning migrations usually occur at temperatures ranging from 41° to 61°F (Lea 1968 and USFWS 1977, as cited in Coffin and Cowan 1995). Eggs usually hatch in approximately 4 to 6 weeks, with fry emergence occurring 13 to 23 days later. In the Maggie Creek and Rock Creek subbasins, fry always are present by July (AATA International 1998c,d; Dunham and Vinyard 1996). Fry usually move out of the tributary streams during increasing flows in the fall and winter. However, some juveniles may remain in the nursery stream for 1 to 2 years before migrating in the spring.

Numerous factors such as fires, floods, droughts, extreme temperatures, nonnative species, destructive land use practices, and habitat fragmentation have affected LCT populations within the Lahontan Basin (Dunham et al. 1997). In general, fragmentation, which results from a loss of connectivity among streams, is a concern because it reduces the recolonization potential, life history development, and habitat diversity (Dunham and Vinyard 1996). Habitat fragmentation exists in the Maggie Creek and Rock Creek subbasins. Impassable culverts beneath the county road on tributary streams are the primary cause of habitat fragmentation in the Maggie Creek subbasin. Lack of suitable habitat mainly due to intermittent or low flows is the cause of fragmentation in the Rock Creek subbasin.

California Floater

Potential habitat for California floater, a freshwater mussel, occurs within the Maggie Creek and Rock Creek subbasins. Two live specimens were found in Maggie Creek in 1993 at the following locations: 1) immediately north of the confluence between Maggie and East Fork Cottonwood creeks, and 2) approximately mid-distance between the confluences of Cottonwood/Maggie and Jack/Little Jack creeks (Worley 1993, as cited in BLM 1993b). No live specimens were observed in surveys of the Humboldt River from Tonka downstream to Beowawe, or in Maggie, Simon, Marys, or Susie creeks (McGuire 1993). Three live California floaters also were found in a 5-mile section of lower Rock Creek Canyon in 1995 (McGuire 1995). No live or shell fragments were observed during surveys in Antelope and Boulder creeks.

Collections in Nevada have indicated that California floater occurs primarily in small, permanent streams with pool or run habitats and substrates consisting of silt, sand, and gravel (McGuire 1995). In Rock Creek, California floaters were observed in pool habitats with silt/sand substrates, depths of 18 to 30 inches, and velocities of 0.5 ft/second. One specimen also was located in a narrow run, with gravel/sand substrates, a depth of 14 inches, and velocity of 1 foot/second.

Springsnails

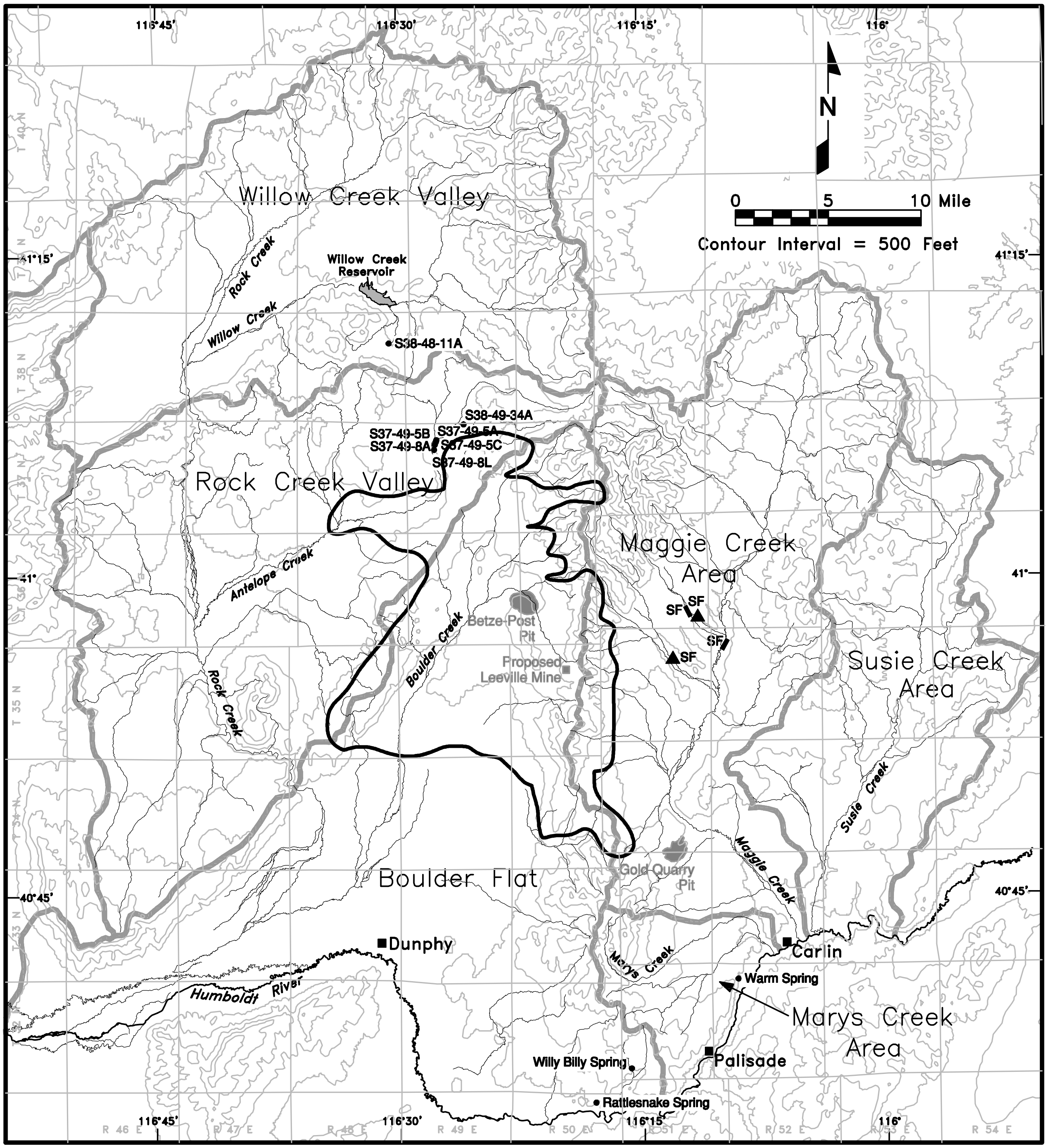
Springsnails, a group of mollusks that are found in perennial springs and seeps, are considered important organisms due to their restricted distribution and native origin. Although the taxonomic classification of springsnails below the family level is difficult, Hershler (1998) has reviewed the taxonomy of *Pyrgulopsis* species. Springsnails have been collected at a limited number of springs and seeps within the Goldstrike Mine study area (see Figure 3.6-2).

Based on surveys conducted in 65 springs and seeps in 1992, springsnails were collected at 3 sites (McGuire 1992). *Pyrgulopsis* was collected in Willy Billy Spring (unnamed tributary flowing into Buck Rake Jack Creek) and Rattlesnake Spring (unnamed tributary flowing into the Humboldt River). *Pyrgulopsis bryantwalheri* was present in Warm Spring, which is located near the Humboldt River about 3 miles south of Carlin. Estimated densities at these collection sites were 200/m^2 at the spring source and 10/m^2 below the source at Warm Billy Spring, 500 to 1,000/m^2 at Rattlesnake Spring, and 1,000/m^2 at Warm Spring.

Subsequent surveys were conducted in 1995 and 1996 to include seeps and springs found within or near the Goldstrike Mine hydrological baseline study area (McGuire 1995, 1996). Springsnails (*Pyrgulopsis*) were collected in 7 of 41 springs that were surveyed (labeled in Figure 3.6-2). Collection sites included springs along Antelope Creek (T37N, R49E, Sections 5 and 8), an unnamed spring perched above Squaw Creek (T38N, R49E, Section 34), and the spring source for Hot Creek (T38N, R48E, Section 11). Hershler (1995) also reported that springsnails were common in two additional springs located within the Squaw Creek drainage (T38N, R48E, Section 33 and T40N, R47E, Section 32).

Habitat conditions in springs supporting springsnails showed the following characteristics. Springsnails usually were confined to the spring source and a wetted area immediately downstream from the spring. The springs also exhibited low to moderately high discharges (5 to greater than 30 gpm), stable substrates consisting of gravel, cobble, or boulder; and dense growth of aquatic vegetation such as

\A305\DWG\305snail.dwg (layer on: textsels, ddbarrick*) REVISION: 3/10/2000



Legend

- Ground Water Basin Boundary
- Stream
- Maximum Extent of 10-foot Drawdown Contour[1]
- S37-49-8A Springsnail Location
- SF▲ Spotted Frog Collection Sites
- SF▬ Spotted Frog Potential Habitat

[1]See text in Section 3.2.2.1 for explanation

Figure 3.6-2

Known Locations for Springsnail Populations and Spotted Frog Habitat

Ranunculus aquaticus or *Nasturtium* (McGuire 1996, 1992). Springsnails often decline in density downstream of stream sources, presumably reflecting their requirement for stable temperature, chemistry, and flow regime (Deacon and Minckley 1974, as cited in Hershler 1998).

Spotted Frog

The Columbia spotted frog (Federal candidate) occurs in wetland habitats ranging from subalpine forests to low elevation shrublands and grasslands. During the breeding season, they are found near permanent water bodies such as ponds, pools in streams, and springs (BLM 1993b). The water bodies also usually contain emergent vegetation. After the breeding season is completed, frogs can move considerable distances to habitats such as mixed conifer forests, subalpine forests, grasslands, and brushlands that contain sage and rabbitbrush. This species hibernates during the winter in holes near springs or other areas where water is unfrozen and constantly renewed (U.S. Forest Service 1991). The entire upper Humboldt watershed is considered historic and potential spotted frog habitat.

The spotted frog was observed in Newmont's South Operations study area in 1992. The collection sites for this species consisted of sloughs or springs with pools that were located adjacent to Coyote and Little Jack Creeks (JBR 1992e) (see Figure 3.6-2). The spotted frog was not observed during surveys at Antelope, Rock, or Boulder Creeks in 1995 (McGuire 1996). However, a 1-mile section of Antelope Creek (T38N, R49E, Section 25) appeared to represent suitable habitat for this species. Spotted frogs were observed on the east side of the Tuscarora Mountains in Maggie Creek upstream of the Coyote Creek confluence and in old beaver ponds along Coyote Spring Creek (McGuire 1992).

3.6.2 Environmental Consequences

3.6.2.1 Terrestrial Species

Federal agencies, in consultation with the USFWS, are required to ensure that any action that they authorize, fund, or carry out is not likely to jeopardize the continued existence of a Federally listed species or species proposed for Federal listing. The BLM, as the Federal lead agency, is currently working with the USFWS under the informal Section 7 process for Barrick's water management operations.

The impact analysis pertaining to special status species focuses on only those project components or areas (e.g., water management area, Humboldt River, Humboldt Sink) that apply to special status species identified for the project. Potential short- and long-term impacts to wildlife species that may occur at the Humboldt Sink from possible exposure to constituents of concern are discussed for representative wildlife in Section 3.4.2.5. These same project assumptions and impact determinations have been applied to special status species that may use the Humboldt Sink for breeding, foraging, or resting.

Preble's Shrew (BLM-sensitive Species)

Little is known about the potential occurrence of the Preble's shrew in the study area (see Section 3.6.1.1). The potential long-term loss of some seeps, springs, and stream reaches within the drawdown area could reduce the amount of potentially suitable habitat for this shrew species.

As discussed for general wildlife resources in Section 3.4.2, it is anticipated that potential increased flows in the Humboldt River and Humboldt Sink would provide additional water to support existing riparian and wetland communities during the mine's discharge period. Although increased mine water discharges into the Humboldt River also would result in an increase in water withdrawals for irrigation by existing water right holders (see Section 3.2.2.2), a net increase in flows would be expected. Therefore, a short-term increase in available water for wildlife resources would be anticipated. Inundation of some wetland areas near the river may occur from greater water depths, particularly downstream of Comus (see Section 3.2.2.2). It is assumed that slightly greater inundation of some backwater areas from increased flows would occur. Inundation of terrestrial areas along the river would result in an incremental loss of habitat; however, it would be offset by the creation of other habitats along natural sloughs within existing meanders and oxbows that do not currently receive water during normal flows (see Section 3.4.2.4).

Potential impacts to species at the Humboldt Sink from chemical constituents of concern have been examined for representative wildlife species, as discussed in Section 3.4.2.5. Potential impacts to wildlife from future exposure to pit lake water quality are discussed in Section 3.4.2.3.

Sensitive Bat Species (BLM-sensitive Species)

The impact analysis of the six special status bat species (including the two subspecies of the Townsend's big-eared bat) that may occur within the study area and along the Humboldt River focused on the changes to available foraging areas from modifying water depths and riparian vegetation. The potential reduction or loss of perennial surface water resources and surrounding riparian vegetation could affect bats, incrementally reducing the amount of suitable foraging habitat for a number of these bat species listed in Section 3.6.1.1. However, the vegetation density relative to the amount of open water combined with the proximity of possible foraging areas to occupied bat roosts would determine overall habitat values for bats and the extent of anticipated habitat losses or reduction in foraging opportunities. No impacts to bat hibernacula or other communal roosts would be anticipated, since it is assumed that these larger roost sites occur in caves, buildings, or large rock outcrops.

As discussed for other terrestrial wildlife resources, potential increased flows along the Humboldt River and Humboldt Sink would create additional foraging areas for bats, in the form of increased surface water area and improved riparian habitats. Over the life of the dewatering discharges, it is expected that a net gain of backwater habitats would occur along the river corridor.

Potential impacts to species at the Humboldt Sink from chemical constituents of concern have been examined for representative wildlife species, as discussed in Section 3.4.2.5. Potential impacts to wildlife species from future exposure to pit lake water quality are discussed in Section 3.4.2.3.

Bald Eagle (Federally Threatened; Delisting Pending)

The reduction in perennial surface water within the drawdown area would incrementally reduce the potential amount of available foraging habitat for wintering and migrating eagles. However, potential habitat effects would be minimized, based on: (1) the low number of wintering eagles that typically occur within the regional hydrologic study area (i.e., two to six eagles within each of the subbasins, Rock Creek, Boulder Creek, and Maggie Creek); (2) the fact that wintering and migrating birds use both open water areas and the upland habitats for foraging; (3) no drawdown impacts are anticipated for the Willow Creek Reservoir, a prominent site for eagles; (4) no known communal or historic roost sites occur within this study area; and (5) the committed protection measures summarized in Section 1.6 of this SEIS.

Potential effects to bald eagles that occur along the Humboldt River and Humboldt Sink during the mine's water discharges would parallel the effects discussed for general wildlife resources. Increased water levels would be most apparent during the low-flow periods (October through February), resulting in more open water (less freezing) during the late fall and winter and a greater prey abundance.

As discussed above, the potential for adverse impacts to species using the Humboldt Sink from possible bioconcentration of chemical constituents of concern is discussed in Section 3.4.2.5. Potential impacts to wildlife species from future exposure to pit lake water quality are discussed in Section 3.4.2.3.

Golden Eagle (Nevada-listed Species)

Potential impacts to the golden eagle that could occur from the reduction or loss of riparian or wet meadow habitat types would be limited to an incremental reduction in potential foraging areas, if available surface water and associated riparian vegetation were affected by long-term ground water drawdown. However, this raptor predominantly nests and forages in drier, upland areas, and use of riparian drainages and wet meadow areas would be incidental. The potential effects to golden eagles from increased water levels in the Humboldt River and in the Humboldt Sink would parallel those discussed for general wildlife resources in Section 3.4.2.4 and 3.4.2.5, respectively. An overall increase in water availability and maintenance or enhancement of riparian vegetation would result in an associated increase in small mammal populations. Therefore, an incremental increase in the quality of foraging habitat and opportunities along the river and in the Humboldt WMA could be anticipated, even with an increase in water use for irrigation purposes.

Northern Goshawk (Nevada-listed Species)

Potential long-term effects to the northern goshawk could result from reduction or loss of riparian habitats associated with perennial water sources at the higher elevations of the Tuscarora Mountains. Possible impacts to nesting and foraging goshawks would be limited to perennial water sources that are hydraulically connected to the regional ground water system and that support suitable trees for goshawk nest sites and sufficient vegetation for this accipiter's primary prey species. Generally, the northern goshawk preys upon smaller birds; however, the forage composition for goshawks in the Independence Range has been documented as 67 percent ground squirrels (NDOW 2000). The potential effects from changing flows in the Humboldt River and Humboldt Sink would only apply to wintering goshawks, since the Humboldt River Valley occurs at elevations that are lower than those typically occupied by nesting goshawks.

The potential for impacts to individuals using the Humboldt Sink from possible bioconcentration of chemical constituents of concern is discussed in Section 3.4.2.5. Potential impacts to wildlife species from future exposure to pit lake water quality are discussed in Section 3.4.2.3.

Swainson's Hawk (Nevada-listed Species)

The likelihood of Swainson's hawks nesting and foraging within the study area is low, based on this species' current distribution in northern Nevada (see Section 3.6.1.1). If nesting and migrating birds were present, potential impacts to breeding or foraging birds would parallel the discussions for the other special status raptor species (i.e., ferruginous hawk, golden eagle, northern goshawk). Since this hawk species may occupy both upland and riparian areas for nesting and foraging, a potential reduction in available water and/or riparian vegetation could incrementally impact this species' nesting sites and foraging areas. A reduction in potential prey abundance (from invertebrates to small vertebrates) may affect this species' distribution and habitat use in northern Nevada, if present. Potential impacts to the Swainson's hawk from increased water flows into the Humboldt River and Humboldt Sink would be the same as those discussed for general wildlife and special status raptor species. Increased water levels and riparian habitats could result in a correlated increase in potential prey species for both breeding and migrating individuals.

The potential effects to individual birds using the Humboldt Sink from possible bioaccumulation factors are discussed in Section 3.4.2.5. Potential impacts to wildlife species from future exposure to pit lake water quality are discussed in Section 3.4.2.3.

Ferruginous Hawk (Nevada-listed Species)

The long-term reduction or loss of riparian habitats may indirectly affect this raptor species. The success of nesting raptors is often closely associated with the available prey base and relative prey densities, and prey availability is particularly important for nesting ferruginous hawks. Also, because concentrations of ferruginous hawks have been documented using wet meadows in the study area as staging areas prior to fall migration, prey abundance in these wet meadow habitat types may be important to both migrating and nesting birds. Reduction or loss of wet meadow or riparian habitats from drawdown effects could remove habitats for suitable prey, thereby reducing prey abundance and possibly affecting subsequent ferruginous hawk nesting success.

As discussed for other sensitive species, increasing flows within the Humboldt River and Humboldt Sink may increase relative prey bases for area predators during the mine's discharges. For the ferruginous hawk, increasing prey species would be small mammals that may commonly occupy wet meadow or mesic habitats. A possible increase in these small mammal populations from increasing and expanding riparian habitats would likely be utilized by foraging raptors, including the ferruginous hawk.

The potential for impacts to individual birds using the Humboldt Sink from possible bioconcentration of chemical constituents of concern is discussed in Section 3.4.2.5. Potential impacts to wildlife species from future exposure to pit lake water quality are discussed in Section 3.4.2.3.

Osprey (Nevada-listed Species)

No impacts to the osprey would be anticipated from the potential long-term reduction in available surface water seeps, springs, or small streams throughout the study area, since this rare migrant generally is associated with large reservoirs, lakes, and rivers. As discussed for the bald eagle, no effects to Willow Creek Reservoir are expected, and the possibility of individual migrating osprey foraging along the smaller creeks or springs is low. The potential increase in available water in the Humboldt River during the mine's discharge period may result in increased foraging opportunities for migrating individuals. The potential bioaccumulation effects discussed for species foraging within the Humboldt WMA in the long term are presented in Section 3.4.2.5.

Burrowing Owl (Nevada-listed Species)

Based on this owl species' known habitat associations, it is assumed that breeding adults and young predominantly occupy dry, upland communities. However, it could not be determined, based on a preliminary literature review, whether burrowing owls depend on open (free) water or riparian/mesic habitats for foraging. Therefore, a conservative impact analysis for the burrowing owl would be limited to possible long-term loss of available water and possible foraging areas along riparian or wet meadow habitats. Since mesic and riparian habitats often provide a greater diversity and abundance of terrestrial invertebrates, it is feasible that adult owls would forage within these areas, particularly during the brood-rearing period. No impacts to this species' dry, upland nesting habitats would be anticipated. Potential impacts to the burrowing owl from changing water levels in the Humboldt River would be expected to be limited to an incremental increase in possible foraging habitat. However, based on this species' typical nest site selection, use of the river corridor likely would be sporadic and isolated.

Sage Grouse (BLM-sensitive Species)

A potential reduction in naturally occurring seeps, springs, and perennial stream reaches and their associated riparian and mesic communities could ultimately affect the amount of potential brooding and foraging habitat for sage grouse. This incremental habitat loss would be long-term, and it is assumed that the birds that are closely associated with these habitat types would be displaced.

For perspective of potential long-term impacts to sage grouse, available data from the NDOW's statewide sage grouse lek database and the additional data collected by JBR (1992g) within Barrick's drawdown area were compiled for both the drawdown area and within 2 miles of this drawdown area where the highest likelihood of nesting may occur away from the leks.

A quantitative summary of historic lek sites in and near the drawdown area was generated to characterize the overall use of the region by sage grouse. A total of four historic leks have been documented within the drawdown area, including three in the Little Boulder Basin and one in the Tuscarora Mountains. Of these four leks within the drawdown area, three are located in areas where perennial surface waters potentially could be affected. An additional three leks have been documented within 2 miles of the drawdown area boundary (NDOW 1998c; JBR 1992g).

In the event that perennial flows were reduced, the riparian vegetation would likely decrease, reducing the vegetative structure, composition, and diversity. No direct impacts to active or potential lek sites would be anticipated, since leks generally occur in more upland communities (although they are often adjacent to intermittent or perennial drainages). However, there is a potential that nesting and brood-rearing areas could be affected in riparian, wetland, and mesic habitats that could be impacted by ground water drawdown, particularly in the mid to late summer, as the upland forbs desiccate and the broods depend more on the mesic and riparian habitats. Because these brood-rearing areas could be located several miles from leks and nesting areas within the drawdown area, it is difficult to quantify the amount of habitat that could be affected. However, it can be stated that the loss of riparian, wetland, or mesic habitats due to drawdown in these areas would reduce the amount of possible nesting and brood-rearing habitat available, altering sage grouse distribution during summer and autumn and possibly reducing the total sage grouse population.

As stated above, this summary has been generated to aid in characterizing the overall distribution and concentration of active lek sites for the assessment area. It is unknown whether specific lek sites and their associated nesting and brooding habitats may be affected in or near the drawdown area shown in Figure 3.2-25; however, it is feasible that the water drawdown may impact riparian, wetland, and mesic habitats used by nesting and brooding hens. As discussed in Section 3.3.2.1, the potential effects to riparian and wetland habitats total an estimated 150 acres within the area of potential impact (see Figure 3-15). The estimated acres of riparian habitat and wetland areas equal 137 and 13, respectively, which total the 150 acres; however, mesic habitats are not included in this acreage estimate. Given the variables discussed in Section 3.2.2.1, the dated and scattered available information on active lek sites, and the recent habitat loss from extensive wildfire events in northern Nevada, it is difficult, if not impossible, to estimate the percentage of these riparian or wetland areas that are actually used by nesting or brooding sage grouse and the amount of mesic habitat that could be affected. Therefore, the total number of acres of potentially suitable breeding, nesting, or brooding habitats that could be either directly or indirectly impacted in the long term cannot be quantified.

American White Pelican (Nevada-listed Species)

As discussed for the osprey and bald eagle, no impacts to large bodies of water (e.g., Willow Creek Reservoir) are currently anticipated that could support pelican foraging. Since this species is closely associated with lakes or ponds, no impacts to migrating pelicans would be anticipated from future changes in water levels or riparian habitats in the mine areas or along the Humboldt River. The potential effects to fish-eating birds from possible bioaccumulation of constituents of concern in the Humboldt Sink area are presented in Section 3.4.2.5.

White-Faced Ibis (Nevada-listed Species) and Black Tern (BLM-sensitive Species)

The long-term impacts to these two shorebird species within the study area focused on potential long-term effects to naturally occurring water sources and the ultimate reduction in available habitat associated with the artificially created wetlands within Boulder Valley. If present, individual birds would likely use the larger spring sites in the foothills region of the mountain ranges and the perennial portions of streams that support adequate riparian habitat and pools for foraging and cover. The reduction or loss of available surface water and associated emergent plants in these naturally occurring wetland areas could result in the displacement or loss of breeding or foraging individuals, if present. As discussed for other wildlife species (see Section 3.4.2), it is assumed that the riparian communities potentially affected by the mine’s dewatering activities are currently at their respective carrying capacities, given their limited availability in the assessment area. Therefore, loss of surface water and the associated riparian vegetation at historically occupied wetland areas would result in the displacement and/or loss of the individual birds dependent on these resources. This loss may affect the breeding potential of individuals; however, no population-level impacts would be anticipated. The estimated acreages of riparian and wetland habitats that could be affected in the long term are presented in Section 3.3.2.1. Given the variables involved, it is not possible to quantify potential impacts to individual birds or breeding pairs.

As discussed for general water bird species in Section 3.4.2, as the mine discharges diminish in the future, the artificially created wetlands in Boulder Valley would be reduced, as well. The level of available surface water, in addition to the associated riparian and wetland vegetation, would slowly decline, with the drier, more upland communities becoming re-established. However, it presently appears that previously saturated soils have increased soil leaching of salts and minerals. This leaching process would ultimately result in a transition of the present plant communities to a community that supports more salt-tolerant plants. This transition would result in both decreased plant and wildlife species diversity. The dry alkaline soils and more upland vegetation would not be suitable for use by either the white-faced ibis or black tern.

As discussed for other terrestrial species, increased flows in the Humboldt River and in the Humboldt Sink during the mine's discharges would result in an increase in potentially suitable habitat for these two water birds. Following Barrick's dewatering operations, water levels in the sink would be anticipated to return to premining levels, and the resulting incremental loss of habitat along the margins of the sink would be offset by the creation of habitats along the margins of the sink at the new (i.e., premining) water level. The potential for impacts to species breeding and foraging in the Humboldt Sink from possible exposure to chemical constituents of concern is discussed in Section 3.4.2.5.

Nevada Viceroy (BLM-sensitive Species)

Because the Nevada viceroy is associated with willows below 6,000 feet elevation, surface water reductions that would affect the maintenance of willow communities would reduce the amount and quality of habitat for this species. Therefore, reduced flows may reduce willow development, which would affect Nevada viceroy habitat. Increased flows in the Humboldt River due to mine-water discharges could increase riparian habitat (and associated Nevada viceroy habitat) during mine discharge.

Lewis Buckwheat

Impacts to Lewis buckwheat are not anticipated as a result of ground water drawdown since this species is associated with upland habitats and is dependent on seasonal precipitation.

3.6.2.2 Aquatic Species

Lahontan Cutthroat Trout

Drawdown would not affect flows or water quality in streams that support existing populations or potential habitat for LCT. These streams include Little Jack, Coyote, Jack (Indian), Beaver, Little Beaver, Toro Canyon, and Williams Canyon in the Maggie Creek subbasin and Frazer, Willow, Toe Jam, Nelson Lewis, and Rock creeks in the Rock Creek subbasin. In addition, other water management activities pertaining to the pit lake development would not affect water quality in these streams. Since flows or water quality would not be affected in these streams, Barrick's water management operations would not impact LCT.

California Floater

Potential habitat for the California floater exists in Maggie Creek (near the Cottonwood Creek confluence and the Jack/Little Jack confluences) and Rock Creek (Rock Creek Canyon). Drawdown would not affect flows or water quality in the Maggie Creek subbasin or Rock Creek.

Springsnails

Springsnail populations are known to occur in upper Antelope Creek (six locations) and upper Willow Creek (one location) (see Figure 3.6-2). No populations have been found in the Maggie Creek or Boulder Creek subbasins or the remaining portions of the Rock Creek watershed. Three populations also exist in springs near the Humboldt River. Drawdown may reduce water levels in springs and perennial reaches in Upper Antelope Creek. If substantial water level reductions occurred in these springs, springsnail populations could be adversely affected. Drawdown would not affect springs in the Upper Willow Creek area, where one known population exists.

Spotted Frog

The spotted frog has been collected in Maggie Creek upstream of the Coyote Creek confluence, Coyote Spring Creek, Little Jack Creek, and Coyote Creek. Potential habitat also was identified in a 1-mile section along Upper Antelope Creek (see Figure 3.6-2). No spotted frogs or potential habitat were observed in the Boulder Creek subbasin or remaining portions of the Rock Creek subbasin. Drawdown would not affect perennial reaches in the Maggie Creek subbasin where populations have been reported. Potential spotted frog habitat may be adversely affected in Upper Antelope Creek, if water levels were reduced in perennial reaches.

3.6.3 Monitoring and Mitigation

3.6.3.1 Sage Grouse

In addition to the monitoring or mitigation measures that have been identified for terrestrial wildlife in Section 3.4.3, the following measure for sage grouse has been developed. To mitigate the potential long-term loss of sage grouse nesting and brooding habitat in the project area, funds would be established for off-site habitat rehabilitation from past wildfire effects for native sagebrush lands. The amount of this fund would be negotiated between the BLM and Barrick, and habitat improvement would aid in mitigating the potential reduction in riparian and mesic communities from Barrick's dewatering and water management operations. This measure would be in addition to the improvements planned for the Squaw Creek Allotment, as discussed in Section 3.4.3.

3.6.3.2 Spotted Frog

Potential habitat for the spotted frog has been identified in the upper Antelope Creek drainage. As discussed for native fish species, flow monitoring would continue in the upper Antelope Creek drainage to determine if dewatering activities affect potential habitat to the spotted frog. Refer to Section 3.2.1.2 for a description of the existing surface water flow monitoring program.

If flow is reduced compared to baseflow conditions during the low-flow period in upper Antelope Creek, BLM would determine the need for mitigation. If required, mitigation for the spotted frog would be the same off-site enhancement described for native fish (see Section 3.5.3). By improving riparian vegetation and streambank stability in upper Rock, Toe Jam, and upper Willow Creek, habitat would be enhanced in areas considered to be potential habitat for this species.

3.6.3.3 Springsnails

Springsnail populations are known to occur in springs and seeps in upper Antelope Creek and Squaw Creek, which could be affected by dewatering activities. An important part of monitoring for springsnails is to conduct an inventory in suitable habitat to determine the presence of this group of invertebrates within the potentially impacted area. The previous survey conducted by McGuire (1996) inventoried most of the springs and seeps considered to be suitable habitat in this area. However, McGuire's survey did not survey all springs and seeps in the area potentially impacted by Barrick's dewatering activities. The location and abundance of springsnails would be documented and mapped. In addition to the inventory, water levels would be monitored in springs and seeps known to contain springsnails. Based on McGuire's 1996 survey, monitoring would be conducted in the following springs or seeps in upper Antelope Creek: 37-49-5A, 37-49-5B, 37-49-5C, 37-49-8A, and 37-49-8L (see Figure 3.6-2 for the locations of these springs). Monitoring also would be conducted in one spring in Squaw Creek designated as 38-48-34A.

If water levels are reduced in any of these springs, mitigation would be implemented for springs. Mitigation options for springsnails would include flow augmentation, relocation of springsnails, on-site habitat enhancement, or off-site habitat enhancement. Flow augmentation would involve water input into groundwater or surface water that would increase water levels in the six springs listed above. Of these, spring 37-49-8L represents the highest priority spring, since it contained a relatively large population of springsnails. A second option would be to relocate smaller springsnail populations from potentially impacted springs to suitable off-site habitat. The relocation site must not contain other endemic springsnail species, since taxonomy issues have not been resolved at this time.

On-site habitat enhancement would involve fencing around the six springs to reduce grazing activity. Important information to be considered in fencing would include: (1) probability of future dewatering activities that could affect these springs, (2) fencing projects must be coordinated with private land owners, and (3) water must remain available to livestock outside the fenced area either through a pipeline/trough system or fencing design. Off-site enhancement would consist of fencing at other sites that support springsnails, which are located outside of the potential impact area. Potential sites include the spring source for Hot Creek (tributary to Willow Creek Reservoir) and several springs north of Willow Creek Reservoir.

3.6.4 Residual Effects

The residual impacts to sensitive terrestrial wildlife species would be the same as discussed for general wildlife resources in Section 3.4.4. Residual effects could occur for three of the four sensitive aquatic species. There would be no residual impacts to LCT. Residual impacts may occur for springsnails, if flow augmentation is not implemented. Loss of perennial reaches in upper Antelope Creek would be a residual impact to potential habitat for spotted frog.

3.6.5 Irreversible and Irretrievable Commitment of Resources

No irreversible commitment of resources would be anticipated for special status wildlife species associated with this project. However, the loss or long-term reduction in available water, riparian and wetland habitats, or perennial stream reaches would be considered an irretrievable commitment of resources for the Preble's shrew; six sensitive bat species; wintering or migrating bald eagles; foraging golden eagles and burrowing owls; nesting or foraging northern goshawks, Swainson's hawks, and ferruginous hawks; nesting and brooding sage grouse; breeding or migrating white-faced ibis and black tern; and habitat for the Nevada viceroy.

The loss of aquatic habitat in upper Antelope Creek (springs, seeps, and perennial reaches) would be an irreversible and potentially irretrievable impact for spotted frog (potential impact) and springsnails, if the water bodies dry up and flow augmentation is not used as mitigation. In addition, loss of aquatic habitat in lower Rock Creek would be an irreversible and irretrievable impact, if flow augmentation is not implemented. Off-site enhancement involving improved land use practices in the Squaw Valley Allotment could offset some of these impacts.

3.7 Grazing Management

3.7.1 Affected Environment

The study area for grazing management comprises the hydrologic study area described in Section 3.2.1, Water Resources and Geochemistry, Affected Environment. The study area (Figure 3.7-1) primarily consists of public and privately-owned rangeland that is used for livestock grazing and provides habitat for a variety of wildlife species (see Section 3.4.1). Smaller parcels of private property that have been disturbed by mine development or are used as irrigated pastures and cropland also are present within the study area. A large parcel of private property, located in the southern portion of Boulder Valley, is owned and operated by the ELLCO.

Portions of 16 grazing allotments are located in the study area (Table 3.7-1) including the Squaw Valley, Tuscarora/Quarter Circle S, Twenty-five, Boulder Field, T Lazy S, Hadley, Carlin Canyon, Carlin Field, McKinley, Blue Basin, Lone Mountain, Adobe, Adobe Hills, Marys Mountain, Palisade, and Horseshoe allotments. Pastures, permittee(s), permitted active grazing use for public land, percent public land, numbers and kinds of livestock, general season of use, and type of operation for each allotment area are provided in Table 3.7-1. For most of these allotments, public land provides 36 to 86 percent of the livestock carrying capacity. The Blue Basin, McKinley Fenced Federal Range (FFR), and Carlin Canyon allotments consist primarily of private lands with smaller parcels of public land.

The permitted active grazing use (i.e., animal unit months [AUMs]) provided in Table 3.7-1 is for BLM-administered land only and does not account for private lands within each allotment. Cow-calf operations are the most prevalent grazing operations in the study area. The Ellison Ranching Company is the only permittee that manages a ewe/lamb operation within the study area in addition to a cow-calf operation.

Three grazing allotments are located within the area potentially affected by Goldstrike Mine dewatering, including the Twenty-five, Boulder Field, and T Lazy S allotments. Grazing operations in the Twenty-five allotment are managed by the 26 Corporation. The permitted active grazing use on the public land within this allotment is 34,130 AUMs, of which 33,281 AUMs are in areas of the allotment in which public land provides 61 percent of the livestock carrying capacity, and the remaining 849 AUMs are in a fenced parcel that includes some public land. Dean and Sharon Rhoads manage grazing in the Boulder Field allotment, in which public land provides 51 percent of the livestock carrying capacity. The public land provides 838 AUMs within the allotment.

The ELLCO personnel manage grazing operations within the T Lazy S and Marys Mountain grazing allotments and private land in Boulder Valley as one general grazing unit (Gralian 1998). The permitted active grazing use on the public land within this allotment is 11,999 AUMs, of which 11,797 AUMs are in areas of the allotment in which public land provides 44 percent of the livestock carrying capacity, and the remaining 202 AUMs are in a fenced parcel that includes some public land. Approximately 4,000 cow-calf pairs are used to graze rangeland within these allotments and the private land in Boulder Valley. In addition to the cow-calf pairs, yearlings are allowed to graze in Boulder Valley if an adequate amount of forage is available on irrigated pasture and alfalfa fields during the summer. Cows and replacement heifers are wintered in Boulder Valley and typically graze residual forage in the alfalfa fields, barley fields, irrigated pastures, and native rangeland. The irrigated pastures predominantly consist of introduced grasses including smooth brome and orchardgrass.

Some of the water produced from Barrick's dewatering activities is used for irrigation and livestock watering in Boulder Valley. Water used to irrigate approximately 10,000 acres of land for the production of alfalfa, barley, and introduced pasture grasses and provide water to grazing livestock is conveyed via pipelines (Gralian 1998). Irrigated pastures that support introduced grasses are grazed annually.

A livestock exclusion fence has been constructed around the wetland area at Green, Knob, and Sand Dune springs in Boulder Valley to prevent grazing of approximately 1,000 acres of riparian vegetation. This area is a separate pasture within the allotment. As mentioned above, ELLCO manages the T Lazy S allotment, of which the Betze Post Mine Area and Central Native

Table 3.7-1
Grazing Allotments in the Study Area

Allotment	Permittee(s) or Operator(s)	Public Land Permitted Active Grazing Use (AUMs)[1]	Percent Public Land	Number(s) and Kind(s) of Livestock	General Season of Use	Type of Operation
Squaw Valley	Ellison Ranching Company	26,654 142	77 100 (FFR)[2]	7,081 cattle; 8,375-9,600 ewes; 27 horses 12 cattle	March 16 to November 30 Yearlong	Commercial cow/calf; ewe/lamb
Tuscarora/Quarter Circle S	Van Norman Ranches, Inc.	5,068 117	96-100 100 (FFR)[2]	1,455 cattle; 2 horses	April 1 to December 15; Yearlong	Commercial cow/calf
	Dean and Sharon Rhoads	8,646 511	54-100 100 (FFR)[2]	2,202 cattle 850 cattle	April 1 to December 15; Yearlong	Commercial cow/calf and horses
Twenty-five	26 Ranch Corporation	33,281 849	61 100 (FFR)[2]	4,530 cattle; 40 horses 861 cattle	Yearlong for cattle and horses May 1 to May 30	Commercial cow/calf
Boulder Field	Dean and Sharon Rhoads	838	51	543 cattle	March 1 to May 31	Commercial cow/calf
T Lazy S	Elko Land and Livestock Company	11,797[3] 202	44 100 (FFR)[2]	2,718 cattle; 350 cattle	February 15 To November 30; Yearlong	Commercial cow/calf
Hadley	Maggie Creek Ranch LP	4,276 206	49 100 (FFR)[2]	1,119 cattle 202 cattle	April 1 to December 20; Yearlong	Commercial cow/calf
Carlin Canyon FFR	Maggie Creek Ranch LP	51	100	34 cattle	May 1 to June 15	Commercial cow/calf
Carlin Field	Maggie Creek Ranch LP	2,442	100	335 cattle	April 1 to December 20	Commercial cow/calf
McKinley FFR[3]	Maggie Creek Ranch LP	727	100	91 cattle	April 1 to November 29	Commercial cow/calf
Blue Basin	Heguy Ranches, Inc.	4,265	96	584 cattle; 9 horses	April 1 to November 15	Commercial cow/calf

Table 3.7-1 (Continued)
Grazing Allotments in the Study Area

Allotment	Permittee(s) or Operator(s)	Public Land Permitted Active Grazing Use (AUMs)[1]	Percent Public Land	Number(s) and Kind(s) of Livestock	General Season of Use	Type of Operation
Lone Mountain	Hooper, Scott, Mark, Kirk, Lili Wolf, and Jennifer Garret	7,202	64	1,546 cattle; 2,000 cattle; 1,000 cattle	April 15 to July 15; July 15 to September 30; October 1 to November 15	Commercial cow/calf
Adobe	Bruce Miller	526	86	221 cattle	April 16 to October 15	Commercial cow/calf
Adobe Hills	Samuel Layton	2,208	61	696 cattle; 10 horses	April 1 to October 30	Commercial cow/calf
Marys Mountain	Elko Land and Livestock Company	1,408	51	324 cattle	February 15 to October 31	Commercial cow/calf
Palisade	Palisade Ranch, Inc.	1,335	47	443 cattle	April 16 to October 27	Commercial cow/calf
Horseshoe	Zeda, Inc.	1,489 140	36-46 100 (FFR)[2]	595 cattle 200 cattle	March 10 to September 30; Yearlong	Commercial cow/calf

Source: BLM grazing leases.
[1]An animal unit month (AUM) is the amount of forage required to sustain one cow/calf pair for a 1-month period.
[2]FFR= Fenced Federal Range.
[3]1,202 AUMs have been suspended due to wild fires that occurred in 1999. This figure (11,979 AUMs) does not reflect this suspension.

pastures are located within the predicted 10-foot drawdown area.

The MCWRP (see Section 3.3) was implemented in 1993 and includes a total of 16 pastures, which are located in the T Lazy S allotment (see Figure 3.7-1). A summary of the MCWRP grazing management activities and riparian habitat conditions within these pastures is provided in Section 3.3, Riparian Vegetation.

Range improvements within the study area include livestock water sources (e.g., improved springs, stock wells, stock ponds, water pipelines, and troughs), fences, seeded rangeland, and cattle guards. Water sources are critical to grazing operations since livestock require water daily; the location of these water sources directly affects the distribution of livestock within an allotment. Livestock water sources include water-related range improvements and natural perennial water sources (i.e., perennial stream reaches, springs, and seeps). Figure 3.7-2 illustrates water-related range improvements, allotment boundaries, and pasture boundaries within or adjacent to the predicted drawdown area. Table 3.7-2 lists the water-related range improvements according to grazing allotment and pasture within or adjacent to the predicted Goldstrike Mine ground water drawdown area (Figure 3.7-2). In addition to water-related range improvements, natural perennial water sources present within or adjacent to the predicted drawdown area are illustrated in Figure 3.7-3.

The Humboldt River is used as a source of water for livestock grazing operations on private and BLM-administered lands within the study area. However, the river does not supply water to livestock within the allotments that may be affected by drawdown. Riparian and wetland vegetation associated with the river and adjacent wetlands has been subjected to grazing for many years. In the early 1990s, NDOW conducted wildlife habitat evaluations at various ranches extending from the Dunphy discharge point to Rye Patch Reservoir. Information from these evaluations indicated that the majority of the riparian habitats evaluated were in good condition although some were in fair or poor condition as a result of livestock grazing and flooding (Bradley 1992). No livestock grazing occurs in the Humboldt Sink and Carson Sink areas because they are associated with the Humboldt and Stillwater Wildlife Management Areas, respectively.

3.7.2 Environmental Consequences

3.7.2.1 Impacts from Mine Dewatering and Localized Water Management Activities

Ground water drawdown resulting from mine-related dewatering activities may affect various water sources used by livestock including improved springs, natural springs, seeps, and perennial stream reaches. Table 3.7-2 indicates in bold type the eight water-related range improvements that could be affected by Goldstrike Mine dewatering. Figures 3.7-2 and 3.7-3 illustrate the water-related range improvements and natural perennial water sources that potentially could be affected by ground water drawdown. Impacts are anticipated only for those water sources that are hydrologically connected with the regional ground water system. No impacts to water sources that obtain water from perched or localized aquifers are anticipated. Only stock ponds associated with seeps or springs connected to the regional ground water system potentially could be affected. Water troughs and pipelines associated with improved springs or stock wells also could be affected.

Impacts that may occur as a result of ground water drawdown include reduced flow or complete cessation of flow from water sources. The long-term loss of water sources would result in the reduction or loss of permitted active grazing use within a grazing allotment if alternative water sources are not present within the vicinity of the affected water sources or if loss of water sources is not mitigated. The reduced flow or change in water source from perennial to intermittent would result in a reduction in season of use or affect livestock distribution, which also would affect perennial active grazing use. Drawdown impacts could be localized to water sources within one or several allotment pastures. The loss of the majority or all water sources within these pastures would likely affect livestock distribution, forage utilization, and grazing management operations.

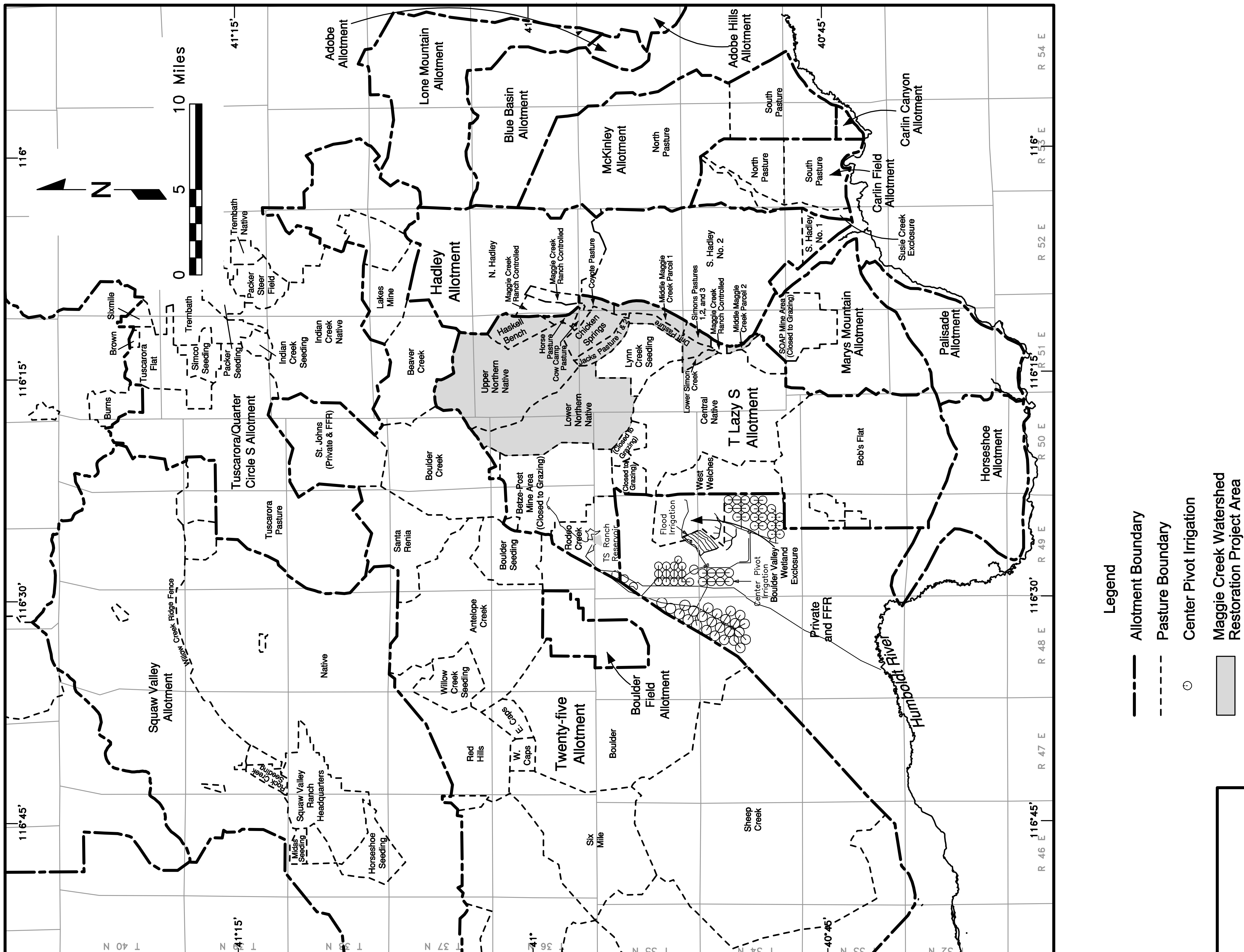


Figure 3.7-1

Grazing Allotments and Pastures

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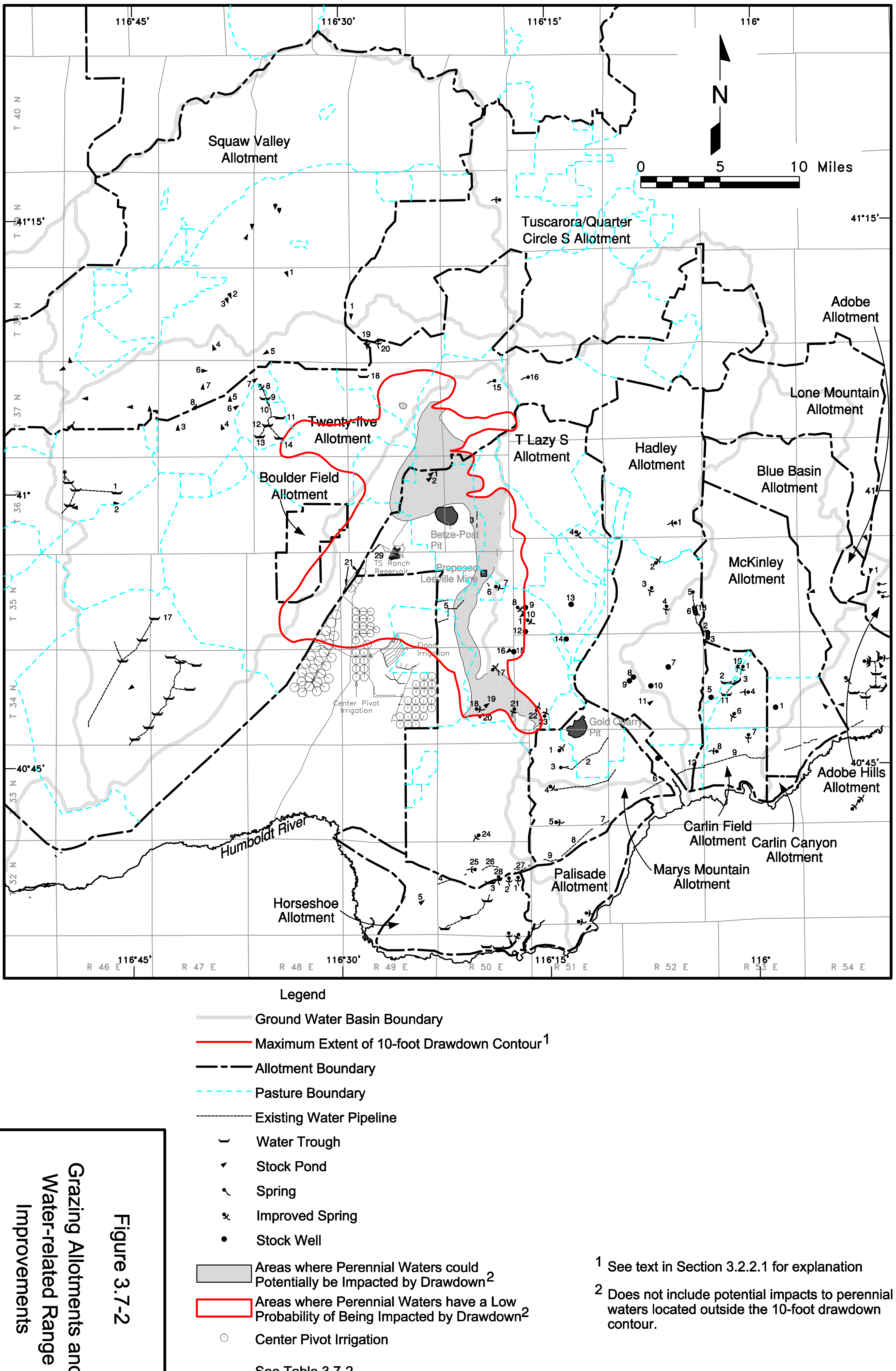

[1] See text in Section 3.2.2.1 for explanation

[2] Does not include potential impacts to perennial waters located outside the 10-foot drawdown contour.

Figure 3.7-2

Grazing Allotments and Water-related Range Improvements

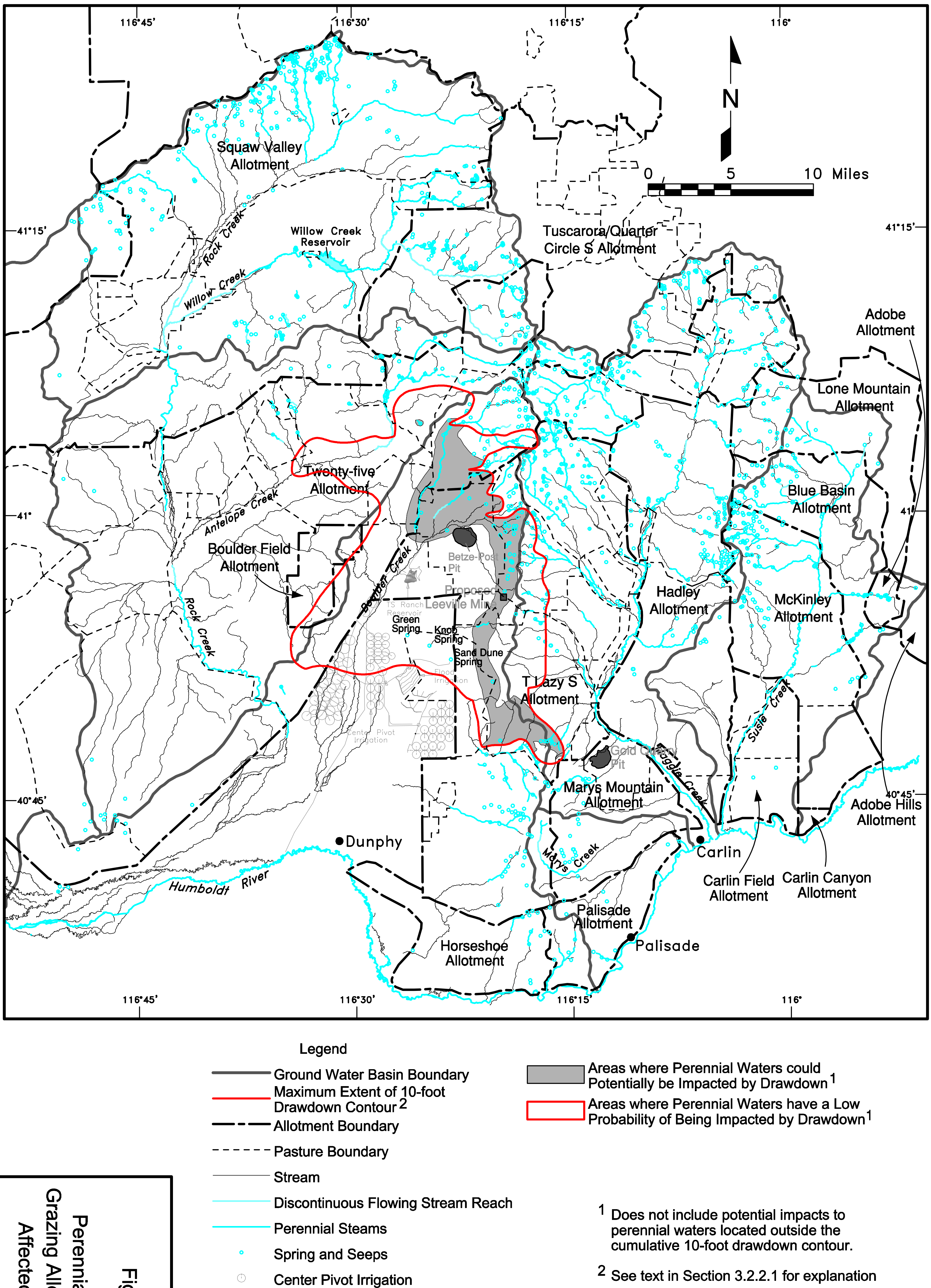

Figure 3.7-3

Perennial Waters Within Grazing Allotments Potentially Affected by Drawdown

Table 3-7.2
Water-related Range Improvements Within the 10-foot Drawdown Contour

Grazing Allotment	Pastures	Water Source Number[1]	Water Source Type	Legal Description
Twenty-five	Unknown	1	Water pipeline and trough	T36N, R46E
	Six Mile	2	Stockwater pond	T36N, R46E
	Red Hills	3	Stockwater pond	T37N, R47E
	Red Hills	4	Stockwater pond	T37N, R47E
	Red Hills	5	Stockwater pond	T37N, R47E
	Red Hills	6	Stockwater pond	T37N, R47E
	Red Hills	7	Stockwater pond	T37N, R48E
	Willow Creek Seeding	8	Improved spring	T37N, R48E
	Willow Creek Seeding	9	Water trough	T37N, R48E
	Willow Creek Seeding	10	Water pipeline	T37N, R48E
	Willow Creek Seeding	11	Water trough	T37N, R48E
	Willow Creek Seeding	12	Water trough	T37N, R48E
	Willow Creek Seeding	13	Water trough	T37N, R48E
	Willow Creek Seeding	14	Water trough	T37N, R48E
	Boulder Creek	15	Spring	T37N, R50E
	Beaver Creek	16	Spring	T37N, R51E
	Sheep Creek	17	Water trough and pipeline	T35N, R46E; T35N, R47E
	Santa Reina	18	Water trough	T37N, R49E
	Santa Reina	19	Improved spring	T38N, R49E
	Santa Reina	20	Improved spring	T38N, R49E
	Boulder	21	Water pipeline	T35N, R49E
Boulder Field[2]	(No water-related range improvements located in the project vicinity)			
T Lazy S	Betze Post Mine Area	1	Stockwater pond[3]	T36N, R49E
	Betze Post Mine Area	2	Stockwater pond[3]	T36N, R49E
	Betze Post Mine Area	**3**	**Water pipeline**	**T36N, R49E**
	Chicken Springs	4	Improved spring[4]	T36N, R51E
	Central Native	**5**	**Water pipeline**	**T35N, R50E**
	Leeville Mine Area	6	Water pipeline	T35N, R50E
	Leeville Mine Area	**7**	**Improved spring[4]**	**T35N, R50E**
	Central Native	8	Improved spring[4]	T35N, R51E
	Central Native	9	Stock well[4]	T35N, R51E
	Central Native	10	Stockwater pond[4]	T35N, R51E
	Central Native	11	Improved spring[4]	T35N, R51E
	Central Native	12	Stock well[4]	T35N, R51E
	Lynn Creek Seeding	13	Stock well[4]	T35N, R51E
	Lynn Creek Seeding	14	Stock well[4]	T34N, R51E
	Central Native	15	Stock well[4]	T35N, R51E
	Central Native	16	Stockwater pond[4]	T34N, R50E
	Central Native	**17**	**Improved spring[4]**	**T34N, R50E**
	Central Native	**18**	**Improved spring[4]**	**T34N, R50E**
	Central Native	**19**	**Stockwater pond**	**T34N, R50E**
	Central Native	20	Stockwater pond	T34N, R50E

Table 3-7.2 (Continued)
Water-related Range Improvements Within the 10-foot Drawdown Contour

Grazing Allotment	Pastures	Water Source Number[1]	Water Source Type	Legal Description
	Central Native	**21**	**Improved spring[4]**	**T34N, R50E**
	Central Native	**22**	**Improved spring[4]**	**T34N, R51E**
	Central Native	23	Improved spring[4]	T34N, R51E
	Bob's Flat	24	Improved spring[4]	T33N, R50E
	Bob's Flat	25	Improved spring[4]	T32N, R50E
	Bob's Flat	26	Water pipeline	T32N, R50E
	Bob's Flat	27	Water pipeline	T32N, R50E
	Bob's Flat	28	Improved spring[4]	T32N, R50E
	Rodeo Creek	29	Water pipeline	T36N, R49E

Sources: Master Title Plats; BLM 1993b; BLM 1996a.
[1]See Figure 3.7-2.
[2]Allotment does not have pastures.
[3]BLM 1996a.
[4]BLM 1993b.
Note: **BOLD** indicates water-related range improvements within areas potentially affected by Goldstrike Mine ground water drawdown.

Reductions in the number and distribution of water sources and reductions in permitted active grazing use would affect grazing permittees by requiring them to find additional rangeland for livestock or to reduce their herd size within the affected pasture or allotment to appropriate stocking levels as determined by the BLM. Permittees would likely try to find additional pasture to accommodate their grazing operations, otherwise the permittees would likely be subjected to economic losses if mitigation does not occur. Currently, all allotments and active permitted grazing use within the Elko District are adjudicated and the option of finding alternative rangeland for grazing is severely limited due to the limited amount of private land in the area.

Specific impacts to natural perennial water sources within the study area are described in Section 3.2.2.1. Table 3.7-2 indicates in bold type the eight water-related range improvements that could be affected. Some of the water sources in the Twenty-five and T Lazy S allotments potentially could be affected by drawdown. Impacts to water sources would not likely occur within the Boulder Field allotment, since water-related range improvements or natural perennial water sources are not present within the predicted drawdown area. Potential impacts to water sources in the Twenty-five and T Lazy S allotments are described in the following sections.

Twenty-five Allotment

Impacts to water-related range improvements in this allotment are not anticipated as a result of ground water drawdown. A portion of Boulder Creek, located in the western portion of the Boulder Creek pasture, could potentially be affected by ground water drawdown. This segment of Boulder Creek represents approximately 30 percent of the natural perennial water sources in this pasture. The potential long-term loss of these natural perennial water sources may result in the long-term loss of permitted active grazing use or affect forage utilization. The upper portions of Boulder and Bell creeks, springs, and seeps in the central and eastern portions of the pasture would likely be unaffected by ground water drawdown and would provide alternative water sources for livestock.

T Lazy S Allotment

Approximately 25 percent of the water-related range improvements and approximately 10 percent of the natural perennial water sources in this allotment could be affected by ground water drawdown. Eight water-related range improvements, including one stockwater pond, two water pipelines, and five improved springs, could be affected by ground water drawdown (see Table 3.7-2). One water pipeline is located in the Betze-Post Pit area and one improved spring is located in the Leeville mine area, both of which are closed to grazing. Six improvements are located in the Central Native pasture. In addition, approximately 40 percent of the natural perennial water sources located in the northwestern and southern portion of the Central Native pasture could be affected by ground water drawdown. The potential long-term loss of these water sources may result in the long-term loss of permitted active grazing use or affect forage utilization. Alternative water sources in the pasture that would likely be unaffected by drawdown include nine water-related range improvements and seeps and springs in the higher elevations of the Tuscarora Mountains.

Natural perennial water sources in the western portion of the Lower Native pasture also could be affected by ground water drawdown; these sources represent approximately 20 percent of the natural perennial water sources in this pasture. Alternative natural perennial water sources that would likely be unaffected by drawdown are present in the central and eastern portions of the pasture.

3.7.2.2 Impacts to the Humboldt River

During the period of mine dewatering discharge, slightly increased water levels within the Humboldt River floodplain would likely increase the areal extent of herbaceous wetlands immediately adjacent to the river channel. Forage production and the carrying capacity of these narrow areas also would likely increase temporarily. Discharge waters reaching the Humboldt and Carson sinks would not affect grazing management since livestock grazing is not allowed within these areas. After mine dewatering discharges cease, reduced baseflows could decrease the extent of herbaceous wetlands used for grazing immediately adjacent to the river.

3.7.3 Monitoring and Mitigation

Water sources, including water-related range improvements and natural perennial water sources, may be lost as a result of Goldstrike Mine ground water drawdown. Barrick is responsible for long-term surface water monitoring (see Section 3.2.3) of water sources in the areas that could be affected by ground water drawdown. In pastures where grazing is allowed, the BLM would monitor forage utilization levels.

If water sources are lost, Barrick would enter into arrangements with existing area ranchers or the BLM, in the case of public land or private land where the BLM has easements or a share of the water improvement, to replace stockwater loss caused by mine dewatering. Barrick would use its existing water rights or obtain additional well permits to provide such replacement water. Mitigation measures applied to seeps and springs that may be affected could include, but are not limited to reducing livestock utilization, fencing seeps and springs with wetland/riparian vegetation, and providing other sources of livestock water.

3.7.4 Residual Effects

Residual effects of long-term loss of livestock water sources associated with Goldstrike Mine dewatering are not anticipated with the implementation of monitoring and mitigation measures (see Section 3.7.3).

3.7.5 Irreversible and Irretrievable Commitment of Resources

The loss of forage in wetlands and riparian areas affected by drawdown would be an irretrievable commitment of resources. Livestock water sources (i.e., seeps, springs) lost as a result of drawdown would be replaced (i.e., stock wells); however, the replacement of these water sources would not provide the surface water and saturated soils needed for wetland or riparian vegetation used as livestock forage. The water sources and associated forage are anticipated to recover in the long term (after 100 years).

3.8 Socioeconomics

This section presents a qualitative analysis of the extent to which social and economic impacts may occur from Barrick's dewatering operations.

Dewatering discharges to the Humboldt River (which are not currently planned) could provide additional water for crop irrigation. Discharges would not be likely during the summer irrigation months, so an increase in available irrigation water would be limited to additional storage in Rye Patch Reservoir with some increase in ground water storage along the river due to the higher water level during discharges. While any discharges to the river may cause additional flooding due to increased flow, the incremental increase in flow associated with Barrick's discharge is expected to be minimal. During periods of exceptionally high river flows with the potential for flooding, Barrick would cease water discharges throughout the high-water period; therefore, additional flooding due to Barrick's operations is not expected to occur.

Dewatering and the necessity for disposing of the water has led to the development of an additional 8,000 acres of irrigated hay fields with resulting hay production. Increasing the supply of hay in the region has created downward pressure on prices, and it can be concluded that the additional acreage in production has reduced costs to ranchers who buy hay for their cattle, and probably decreased income for regional competitors who produce hay for sale. As dewatering rates decline and eventually cease, the 8,000 acres of irrigated hay would be gradually removed from production, resulting in a decrease in the supply of hay within the area, and price competition would be normalized.

The cessation of dewatering operations would result in the accumulation of a ground water supplied lake in the mining pit. The resulting pit lake would lose an estimated 2,700 acre-feet of water annually to evaporation. This loss would reduce the amount of water available within the basin that might otherwise be applied to productive applications such as livestock grazing or crop irrigation.

Dewatering would likely result in some reduction of water availability for cattle grazing within the area affected by drawdown, particularly during the summer months. This drawdown could induce a slight reduction in livestock production or increased costs due to the necessity of utilizing alternative methods of providing water. This potential impact will be mitigated by Barrick's commitment to replace lost water sources.

A slight reduction in fish and wildlife resources associated with surface water and riparian areas impacted by the drawdown may occur as a result of dewatering. This impact may result in a very small reduction in hunting and fishing activities and success.

Refer to Section 5.8 for a discussion of potential cumulative socioeconomic impacts.

3.9 Native American Religious Concerns

Barrick's proposed dewatering and water management operations are not anticipated to affect resources of importance to Native Americans, including the Tosawihi Quarry and Rock Creek traditional cultural properties.

Refer to Section 5.9 for a discussion of potential cumulative impacts to Native American religious concerns.

3.10 Environmental Justice

Since publication of Executive Order (EO) 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations in the Federal Register on February 11, 1994 (59 FR 7629), Federal agencies has been developing a strategy for implementing the order. Currently, the BLM relies on the Environmental Justice Guidance Under the National Environmental Policy Act (NEPA) prepared by the Council on Environmental Quality (1997), in implementing EO 12898 in preparing NEPA documents.

Pursuant to EO 12898 on Environmental Justice, the Federal agencies shall make the achievement of environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations, low-income populations, and Indian tribes and allowing all portions of the population an opportunity to participate in the development of, compliance with, and enforcement of Federal laws, regulations, and policies affecting human health or the environment regardless of race, color, national origin, or income.

EO 12898 requires identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. The EO makes clear that its provisions apply fully to programs involving Native Americans. These requirements were addressed in preparing this SEIS by 1) ensuring broad distribution of public information on the intent to prepare the SEIS through a public scoping process begun in 1994 (see Section 6.2); 2) conducting consultation every four to six weeks with the Battle Mountain, Wells, and Elko Colonies, South Fork Band, Duck Valley Tribe, Western Shoshone Historic Preservation Society and Western Shoshone Defense Project; and, 3) conducting a field tour of the project area on June 22, 1999, in which members of the Wells, Elko, and Battle Mountain Colonies, and South Fork Band participated.

The aim of the environmental justice guidance is to prevent discriminatory placement of projects in and around minority populations in comparison to non-minority communities. The Proposed Action addressed in the SEIS is intended to link existing infrastructure that is situated on private land. Thus, the location of the Proposed Action was not selected in a manner that discriminates against minority populations. The nearest minority community is the Elko Band Colony located just outside the city limits of Elko, approximately 50 miles from the project area.

The project area is located within both the traditional territory of the Western Shoshone and the geographic boundaries established under the Ruby Valley Treaty of 1863. The Te-Moak Tribe of Western Shoshone Indians, a coalition government with headquarters in Elko, is comprised of the Elko, Battle Mountain, and Wells Colonies, and South Fork Band. The Te-Moak Tribal Council has jurisdiction over tribal lands, although the colonies retain sovereignty over local colony affairs, and each has its own separate governing council.

Government, mining, gaming, manufacturing, construction, services, and wholesale and retail trade are the principal sources of employment in both Elko and Eureka counties, with mining clearly dominating the job market in Eureka County. In 1997, of the 4,854 workers in Eureka County, 88 percent were employed in mining. Of Elko County's 20,182 workers, 7 percent were employed in the mining industry. The largest employer in Elko County was the service industries sector, employing 41 percent of the labor force (Nevada Employment Security Department 1997).

The Elko Band Council, the Te-Moak Tribe, the Te-Moak Housing Authority, the Bureau of Indian Affairs, and the U.S. Indian Health Service are the main employers of the Elko Band Colony (Gonzales 1999). Approximately 4 percent of the 250 workers are employed in mining. Currently, the rate of unemployment for the Elko Band Colony is approximately 29 percent for those between 16 and 64 years of age, willing and able to work (BIA 1999). The continuation of mining activities would have minor economic and social impacts for the Elko Band Colony within the context of current economic conditions in Elko and Eureka counties.

The Western Shoshone Historic Preservation Society and the Elko Band Council, a constituent of the Te-Moak Tribe of Western Shoshone Indians, have expressed special concern for the traditional areas of Tosawihi Quarry and Rock Creek. Dewatering activities, with the resultant reduction or loss of flow to springs, could alter the distribution or disposition of spirits associated with water. Maintaining a relationship with these spirits is central to Western Shoshone ancestral and spiritual life. Effects of the proposed dewatering activities on these Traditional Cultural Properties are examined in the technical report, *Cumulative Impact Analysis of Dewatering Operations for the Betze Project, South Operations Area Project Amendment, and Leeville Project*.

No adverse impacts that might differentially affect minority or low-income populations have been identified for the environmental factors analyzed in the Supplemental EIS. Because the local minority American Indian communities are culturally affiliated with many archaeological sites, human remains, and traditional cultural areas within the region, effects on these resources may represent differential levels of impacts to these local minority groups. Effects on such cultural resources are being considered in compliance with numerous Federal and state laws in addition to NEPA.

3.11 Relationship Between Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

There would be long-term reductions in surface water flows during operations and postclosure associated with ground water drawdown from pit dewatering. Long-term impacts to riparian and wetland areas, wildlife, and other water-dependent resources would result from these reductions in surface water flows. The short-term use of resources during the project would result in beneficial impacts associated with the additional availability of water for irrigation in Boulder Valley and water uses along the Humboldt River. These impacts are expected to end upon cessation of water management operations.